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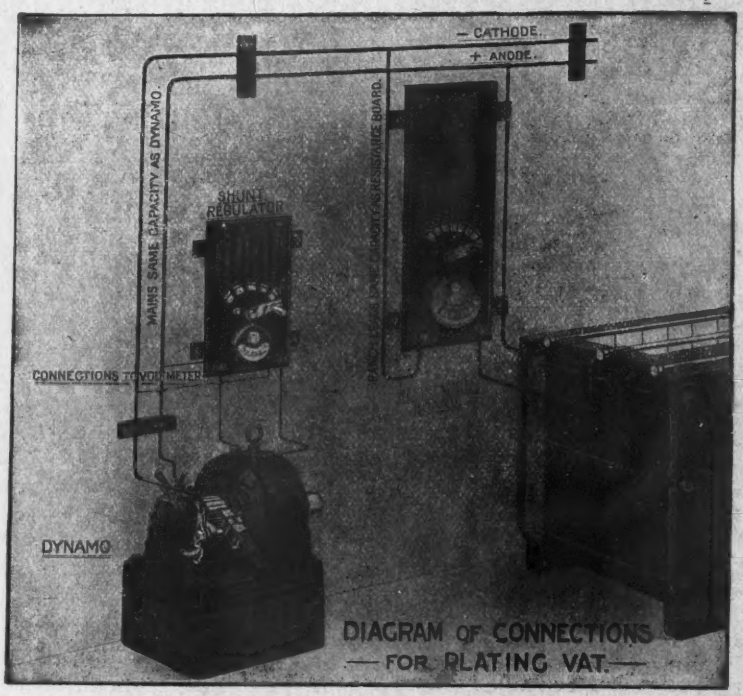

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# ELECTRICAL REVIEW.

VOL. LXXIX. JULY 21, 1916. No. 2,017.

## ELECTRICAL REVIEW.

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## ELECTRIC LIGHTING IN PARIS.

A REVIEW of the situation of the electric lighting industry in Paris, and of the experiences of the companies engaged in the supply of electricity in the environs of the French capital and in the provinces, is contained in the annual report for 1915 of the Compagnie Parisienne de Distribution d'Electricité, which was submitted at the general meeting held in Paris at the end of June. It will, perhaps, be remembered that this particular company, which has a combined share and loan capital amounting to nearly £8,000,000, represents an amalgamation of the former Secteurs or concession areas which were held by several companies within the district of the municipal administration of the City of Paris, and which were combined in accordance with an agreement entered into between the Comité des Secteurs on the one part, on behalf of the Compagnie Parisienne, and the Paris Municipal Council on the other. The agreement conferred a monopoly of supply until June 30th, 1940, whilst, at the same time, it imposed upon the company the obligation to install improved generating plant by a fixed date, and to extend and transform the distributing network without interfering with the supply to the then existing consumers. This work has been carried out at an expenditure which has not exceeded the estimated £8,000,000, and the city has thereby become the owner of the entire works without having to provide any money whatever, as the undertaking will pass into municipal possession on the expiration of the concession in 1940.

The continuation of the war in 1915, the report states, had the effect of considerably reducing the lighting requirements in Paris on the one hand, while, on the other, additional expenses were incurred which were considerably in excess of the increases which were taken into consideration when the agreement was concluded with the City. The contract was entered into on the basis of the progressive development of the system of supply. Thus, notwithstanding the comparatively high charges made to consumers prior to the company taking over the entire work on January 1st, 1914, the aggregate sales of the several companies amounted to 42,855,000 KW.-hrs. in 1906, and they had risen to 87,369,000 KW.-hrs. in 1910, partly owing to extensions of the mains, and partly in consequence of the reduction in prices. It had been expected that this rate of expansion would continue, and the charges to the consumers were further lowered at the beginning of 1914, the scale apparently being subject to no alteration during the currency of the concession, and being held to be justified by the consideration that the prices of raw materials which the company would have to purchase, would only vary in accordance with the fluctuations in the situation of general prosperity. It was under these assumptions that the city was able to stipulate that the redemption of the capital of £8,000,000 should be effected by means of annuities derived from the net profits, and that the city should receive by way of rent from 10 to 25 per cent. of the amount of the company's revenue, and a progressive share in the annual profits which were in excess of 6 per cent. of the capital invested by the company in the form of ordinary shares, which

represents one-half of the total of £8,000,000. On the other hand, the city undertook to bear the charge of any increase in the wages of the company's *personnel* which might be granted on its initiative and in accordance with the assimilation of the *personnel* with the municipal workers. But the agreement did not place at the company's charge the consequences of *force majeure*, and a possible diminution in the receipts was only foreseen in case new methods of production, or the use of new forces, brought about a reduction of at least 20 per cent. in the cost of generation and distribution, in which event the city could require the company to lower its selling prices.

The war, however, has overthrown all former calculations. In the case of the lighting supply, the charges for which permitted of compensation being obtained to some extent for the low price charged to power users, the consumption in 1914 declined to 54,157,000 KW.-hrs., notwithstanding the favourable results in the first seven months, and a further decrease to 38,579,000 KW.-hrs. took place in 1915. The company is co-operating in the national defence by furnishing energy at low prices to all the firms in the vicinity of Paris who are engaged on the production of war material, and the consumption for motive power purposes reached 31,204,000 KW.-hrs. last year, or nearly one-half of the total turnover.

The increase in the working expenses in 1915 is attributed to the scarcity of labour, the inefficiency of workers employed in substitution for the skilled men who were mobilised, the difficulty of obtaining materials and their high prices, the higher cost of work undertaken by contractors, and the costliness of coal, which had to be procured almost exclusively from England. In this connection, we note that the company's consumption of coal is approaching a rate of 200,000 tons per annum; before the war the cost amounted to 19s. 7d. per ton, and it averaged £1 14s. 4½d. per ton in 1915. The latter was merely the result of the operation of old contracts, which, however, it was impossible for exporters to execute in full, whereas for recent contracts it has been necessary for the company to pay approximately £4 16s. per ton. It is considered that unless the new arrangements concluded between the French and English Governments largely modify this disquieting situation, the company will have to pay an additional sum of £400,000 this year for the delivery of coal. Under the circumstances, the company contends that as the war has completely disturbed the state of equilibrium between the reciprocal clauses of the agreement between the two parties, the company is entitled to ask the city for compensation, as it is held to be unfair for the city and the consumers to derive all the advantages of the agreement on the one hand, and on the other for a crushing burden to be imposed upon the company, which only receives a relatively small portion of the fruits of its industry, and has a limited concession. The company, which has made an application to the City Council for compensation, argues that the demand is justified in law and in equity, and it is stated to be in conformity with a recent decision of the Council of State in a similar case. We cannot recall the decision in question, but as the company has been able to declare out of net profits of £209,000 in 1915 a dividend at the rate of 4 per cent. on the ordinary share capital of £4,000,000, the claim for compensation may not receive the consideration which is desired. The company has been remarkably more successful than the Paris Gas Co., which incurred a loss of £800,000 last year. It is true that this loss was recouped by the Municipal Council and the company thereby placed in a position to pay a dividend, but this contingency, we believe, was provided for in the contract between the Gas Co. and the Municipal Council some years ago.

**The Rights of a German-owned English Company.**

The question whether a company in which practically all the shareholders are enemy subjects can bring actions in the King's Courts has been discussed, but by no means satisfactorily answered, in the now well-known case of *Continental Tyre and Rubber Co., Ltd. v. Daimler Co., Ltd.* This is one of those cases in which an issue which is of absorbing interest to the public, and to the commercial world, has become confused in a welter of legal procedure and conflicting judicial opinion. An action was commenced in October, 1914, by what is called a specially endorsed writ, to recover the sum of £5,605, the writ being issued by the company's solicitor on the instructions of the secretary. Under this procedure, the plaintiffs are entitled to obtain summary judgment unless the defendants can show that, *primâ facie*, they have a right to defend. The defendants asked for leave to defend on the grounds (1) that the company was in fact an alien company with whom it was illegal, apart from a licence from the Crown, to hold any commercial intercourse, which included the payment of money for a trade debt; and (2) that the secretary had no authority either to instruct the company's solicitors to issue the writ in the action or to give a receipt for the money when recovered.

It will be seen that the Court was not bound to decide whether the plaintiff company was entitled to sue; a decision that the secretary had no authority, or that the defendants had a *primâ facie* right to defend, would suffice. The Court might, and, in fact, did, refrain from deciding the main and most interesting question. In the House of Lords, all the Law Lords were of opinion that the secretary had no authority *virtute officii* to commence actions on behalf of his company, and that, on the facts, he had no such authority from the directors. That was quite enough to decide the case. The majority of the Court of Appeal and five members of the House of Lords were of opinion that it was a case which ought to be investigated, and not one for summary judgment. It remained for two very distinguished lawyers to pronounce certain *obiter dicta* to the effect that the plaintiff company, as an illegal association, ought not to be allowed to sue. In the Court of Appeal, Lord Justice Buckley (as he then was), differing on this point from all his learned brethren, held that in the circumstances the company was an alien enemy, and could not sue in the King's Courts. No less an authority than Lord Halsbury took the same view in the House of Lords. But the net result of the whole litigation is that the case "went off" on a mere side issue, and the main question is still undecided. What the two great judges whose names have been mentioned said, is entitled to considerable respect; but they uttered mere *obiter dicta*, and, to use the words of an old judge, an *obiter dictum* is "a mere individual utterance which bindeth none, least of all the lips of him that uttered it."

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**Lead.**

Fundamental conditions in this metal have really undergone no change of late, the tendency of the market having been entirely subject to the control of operations at the hands of the Ministry of Munitions. As we suggested, three weeks ago, would be the case, the price has come down a good deal further since then, and even now it is highly premature to assume that the market has reached "bottom." Nobody, at any rate, believes that any recovery of importance could be otherwise than of a temporary character. Prices across the Atlantic still stand at a high parity level, precluding the possibility of any sales being made in the London market at present. The tonnages reaching this side appear to continue of respectable dimensions, and

more than equal to cope with all needs, although the figures as officially returned are most incomplete and most misleading since controlled supplies, or the considerable quantities imported by the authorities, are not included in the returns. The statistical position is thus absolutely a mystery. After the recent further break to below £28 for near delivery, offers of the latter having been made more sparingly, the position somewhat stiffened, but the general trade demand has remained on the whole very quiet, and the market has become very irregular. Judging from the slackness of the inquiries experienced for forward deliveries for some time past, there is certainly no eagerness to anticipate needs, and the result has been that the discount on forward positions has widened considerably to about 30s. a ton.

In view of the not unreasonable assumption that the authorities have made all necessary arrangements to have their needs for munitions well provided for during the remainder of the war, and while ordinary trade requirements are likely to continue abnormally restricted until the war is over, it is hardly possible that any very severe pinch will be experienced by consumers, unless mining operations are seriously interfered with by unforeseen circumstances. It is true that heavy quantities are now being soaked up by munition work in warring countries. French needs are particularly heavy, as may be gathered from the much increased imports made by France this year, the great bulk of the supplies being drawn from Spain direct. During the first four months of this year no less than 21,500 tons of Spanish lead were sent to France, against only 9,816 and 2,324 tons during the same period in the two previous years respectively. The total French imports for that period represent 26,564 tons, or some 13,500 tons more than in the previous year. There is no doubt that good stocks are held in reserve in France, although it is possible that the movement of fresh supplies from Spain may be delayed by the congestion of traffic at the railways, since complications have just lately arisen regarding shipping from the West Coast of Spain to Mediterranean ports, while shipping companies are apprehensive of disturbances through German submarine attacks. The quantities of Spanish lead coming to this side are still of fairly good proportions, though much smaller than last year, owing to the big tonnage absorbed by France, but Australian metal continues to arrive in large quantities, and there is not much doubt that the supplies will continue ample enough to enable the authorities to keep down prices.

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**Educational Reform.**

During the past few weeks great activity has been observed in circles concerned with educational matters, particularly on the scientific and technical side. Last month the professorial staff of the Imperial College of Science and Technology submitted memorials to Lord Crewe pointing out the urgent necessity for taking active steps towards educational reform, especially in connection with the teaching of science; since then a deputation representing science professors, the Army and Navy, commercial men, and parents has met a committee of headmasters from twelve of our leading public schools and urged the pressing need of giving more time to the study of English and other modern languages, of infusing a scientific spirit into the whole school instead of treating scientific subjects as separate branches of study, of abolishing compulsory Greek for science students, of improving the teaching of mathematics, and of introducing chemistry and applied science into the examinations for first-class clerkships in the Civil Service; the Council for Organising British Engineering Industry has issued a report, of which we published an abstract in our last issue, dealing with the training of technical students for all grades of industrial rank; last week Lord Haldane in the House of Lords drew attention to the necessity of reform in our system of secondary education, and the Board of Education issued a report of exceptional interest and importance on the subject of technical education, which followed very similar lines. This report was drawn up by a consultative committee appointed as long ago as 1913; its proceedings were in the main suspended on the outbreak of the war, but attention has been given to the training of students in science and technology to supply the needs of commerce and industry, and we are glad to see that the Committee fully realises the extreme urgency of the matter, and the necessity of acting *at once*. With this object in view, the Committee recommends the provision by the Government of the sum of £339,500 a year, to strengthen the higher parts of selected secondary schools, and to provide scholarships to enable meritorious students to proceed from secondary schools to technical colleges and universities, from secondary schools to senior technical schools, and from evening classes and works schools to technical colleges, &c. We are glad to see that the Committee would spread the net wide—how many Faradays may not have been lost to the nation for want of the opportunity to develop their innate genius!—and would not only endow impecunious students with the means to pursue their studies, but even advocates the modification of matriculation tests, to enable them to enjoy the full privileges of a university career subject to their showing merit under scientific and mathematical tests alone, and passing an examination in the English language.

The Committee rightly points out that such expenditure would be abundantly repaid by the benefits accruing to the nation from the increased supply of scientifically-trained students—a fact which, in the past, the politicians by whom we are governed have been utterly unable to appreciate. It adds a proviso to this forecast—"provided that the scholars are well selected," and elsewhere remarks that it has found the provision of scholarships at certain stages relatively abundant, at others absent or deficient; these comments are amply justified by the facts. It is a condition indispensable to success that scholarships shall be awarded on the score of proved merit, and that alone; and it is desirable that the provision of scholarships shall be regulated and co-ordinated in such a way that merit, wherever found, whether in the town or in the country, shall be afforded equal opportunity of proceeding onwards to the very highest degree of training and development.

The Committee points out, also, that the recommendations made are only a beginning; large capital sums will be required, as well as annual subsidies to universities and schools of technology, besides the establishment of new schools, to make good our shortcomings in the past, and to bring our existing institutions into correspondence with the national needs. In this respect, we shall do well to learn from our enemies. The German Government spends in subsidies to universities 1½ millions a year—the British Government, in England and Wales, only £265,000. It is necessary, also, to provide maintenance grants, to counteract the temptation to withdraw students from schools when they attain the age of 16 to 18 years and are capable of earning wages, and the encouragement of research after graduation calls for additional funds.

All these are excellent recommendations. We regret that we cannot deal with them at greater length, but we cannot too strongly urge our readers to support the movement which has been set on foot by every possible means, in order that this country may be enabled to maintain its supremacy in industry and commerce after the war.

## NOTES ON ELECTROPLATING.

By S. V. THORP.

*E.M.F. for Plating.*—When an electrolyte is being decomposed, the elements thus liberated have a tendency to re-combine, and this tendency also tends to oppose the flow of current by setting up a back E.M.F., so it follows that for every electrolyte no current can flow unless the E.M.F. applied is at least greater than the E.M.F. of polarisation; that is, there is a minimum E.M.F. below which continuous decomposition will not take place. In the case of water, the chemical affinity of the oxygen and hydrogen corresponds to an E.M.F. of 1·5 volts, so to decompose water continuously an E.M.F. of over 1·5 volts is required.

The voltage for the various baths is variable within certain limits for a given class of work. In any case, the voltage should be carefully adjusted, so as to give the current best suited to the work in hand. Table I gives the approximate voltages for various baths.

TABLE I.—Approximate Voltages for Various Baths.

| Metal. | Volts. |
|---|---|
| Gold ... ... ... ... ... ... | ·5 to 4 |
| Silver ... ... ... ... ... ... | ·5 to 2 |
| Copper (acid bath) ... ... ... ... | 1 to 2 |
| Copper (cyanide bath) ... ... ... ... | 2 to 5 |
| Brass ... ... ... ... ... ... | 2 to 6 |
| Platinum ... ... ... ... ... ... | 5 to 6 |
| Nickel, strike deposit with 5 volts, diminish to | 1·5 to 3 |

*Current required for Plating.*—The amount of metal deposited depends on the current density. Definite rules as to the current density required cannot be laid down, as each metal requires different densities, according to the metallic salt used, the metallic strength of the solution, whether during decomposition the electrolyte is agitated or stationary, and whether the bath is hot or cold. Generally, when the current density is low, the rate of deposition is slow, but the deposit is hard and close-grained. With higher current densities, the rate of deposition is quicker, and the deposit is softer and more crystalline in appearance. If the current becomes excessive, the deposit becomes loose and powdery. Table II gives the current densities suitable for various baths, using a stationary solution.

TABLE II.—Approximate Current Density.

| Metal. | Amps. per sq. ft. of cathode. |
|---|---|
| Gold ... ... ... ... ... ... | ·75 to 1·5 |
| Silver ... ... ... ... ... ... | 1·5 to 4 |
| Copper (acid bath) ... ... ... ... | 5 to 20 |
| Copper (cyanide bath) ... ... ... ... | 3 to 4 |
| Brass ... ... ... ... ... ... | 3 to 4 |
| Nickel ... ... ... ... ... ... | 2 to 8 |
| Tin ... ... ... ... ... ... | 3 to 6 |

By agitation of solutions the current density can be doubled.

*Agitating the Electrolyte for Rapid Deposition.*—In electroplating, the anodes, which may be either cast or rolled, are of the same metal as that being deposited, and their function is to dissolve into the solution as fast as metal is taken from the solution for deposition. In the ordinary course of things, the electrolyte immediately round the anode plate is richer in metal than that round the object being plated. With a weak current this difference is very small, but the rate of deposit is slow. The quicker the rate of deposit, that is, the stronger the current with a given cathode area, the greater will be the difference in metallic strength of the parts of the electrolyte round the anode and cathode. Should, however, the deposition of metal proceed faster than the metallic salts can diffuse from the mass of liquid to the surface of the object being plated, the current will begin to decompose the other compounds present. Taking, for example, a copper-sulphate solution, the $SO_4$ radical will unite with the water of the solution, and thus form sulphuric acid and oxygen. The oxygen, being liberated, is attracted to the anode plate, and forms an insoluble coating of oxide thereon. This increases the internal resistance of the bath, and so decreases the current, and once the anode becomes oxidised it will be unable to dissolve into the solution. The solution will then become poorer than ever, and only a thorough cleaning of the anode will put matters right. It will be seen from the foregoing that, having a still bath, the current, and therefore the rate of deposit, is limited, owing to the necessity for allowing the solution of metal round the anode time to diffuse. This diffusion, and, consequently, the rate of deposit, may be assisted by keeping the solution hot, about 100° F., or by agitating the electrolyte by mechanical means. In some cases a mechanically-driven stirrer is used, but the best method is to blow air through the solution, a pneumatic agitator being employed.

By this system of agitation, which is used largely in copper-plating for electrotyping, and also for nickel-plating, it was found by actual trials that for a given quantity of work, with a stationary solution, the maximum amount of current that could be safely used was 35 amperes at an E.M.F. of 2 volts, giving 70 watts, the time taken being three hours. The same vat was used with an agitator, the same solution and anodes, and an exactly similar load was put into the vat, when a current of 65 amperes at an E.M.F. of 3 volts was used, giving 195 watts, with every success, the time taken being one hour, and the deposit was not only equal to the previous load, but was smoother and brighter. Excellent results have been obtained from plants installed on this system, especially in the cycle, cast-iron, and printing trades.

*Points to Remember.*—In plating it is important to remember that the scientific basis is the same, whether conducted by the amateur or the largest electroplater. The apparatus may be varied according to the requirements of the work, but the principle remains the same whether small or large quantities of work are done. In all branches it is absolutely necessary that the chemicals be pure, and if careless methods and impure chemicals are used, continual trouble will result. Cyanide of potassium must be recognised as the most used, and most important, substance in electrodeposition, nearly all the solutions containing this chemical. The dynamo is the only current-producer used, as to attempt working large plants with batteries is to court constant expenditure. The motive power necessary for the dynamo and the various polishing lathes can be either gas, steam, or electricity. The advantages of using electricity are very great, ease of starting or stopping, economy of space, cleanliness, and maintenance being altogether in its favour.

*The Plating Dynamo.*—For this class of work, special forms of continuous-current dynamos are needed. Designing dynamos for low voltage and high amperage entails difficulties in the design, for the voltage cannot be obtained low enough without either having few convolutions on the armature, or else a weak field-magnet, and machines with weak field-magnets give trouble on account of sparking at the brushes, as also do the machines with few massive conductors and few parts in the commutator. Special care is needed with the brushes and brush-gear; copper gauze brushes are nearly always used, as the drop of potential at the brushes themselves, if carbon brushes are used, is more than twice that of copper gauze brushes, and, with such a low voltage, this would be serious. The brush-gear should be so designed that it can readily be cleaned or adjusted, many makes being very deficient in this respect. The matter of speed is very important. A high-speed dynamo means a lower price, but more frequent renewals, whereas a moderate-speed dynamo is more expensive to manufacture, but has a longer life than a high-speed one of the same output.

A most convenient mode of obtaining current in places where a power supply is obtainable, is by the employment of motor-generators. In some cases the fields of plating dynamos are separately excited, the advantage being the control or variation which can be exercised over the voltage of the dynamo at all loads. Motor-generators lend themselves admirably to separate excitation, having a small exciter coupled direct on to the same shaft. Where a very large collecting surface is needed on account of the large amperage, the dynamos have double commutators connected in parallel with one another.

*The Plating Plant.*—Separate shops should be provided for polishing, plating, finishing, and burnishing; but in small establishments the polishing and finishing may be done in the same shop. The polishing shop, where the surfaces of the work are polished preparatory to plating, is

equipped with high-speed polishing lathes. The dust given off when polishing must be carried away from the face of the worker; the best practice is to fix hoods over the revolving wheels with connections to a duct, and to fix the fan which exhausts the dust at the end of this duct. It is important to remember that however the work is polished, so will it leave the plater, and no amount of finishing will eradicate the faults left by the polisher, because every imperfection left on the article after polishing remains in the same condition after plating. In the plating shop, the plating vats, swilling trough, cleaning and water tanks are situated. In all cases, wooden racks or false bottoms are provided for the operator to stand on while at work, and the shop floor should be provided with a slope to allow water to run off into a drain constructed for the purpose. As in most operations solutions and tanks have to be kept hot, arrangements have to be made for either gas or steam heating. For small plants gas is sufficient, but for larger plants steam is best, being far more economical and handy to use. Burnishing is the last process, and it imparts to metal goods a very brilliant finish, more lustrous than can be obtained by any other process. To do this, steel burnishers are moved backwards and forwards over the surface of the article, which is kept well moistened by a thick paste of soap and water. After burnishing, the soap must be washed off with warm water and the article dried in clean boxwood sawdust, then polished with a soft chamois leather. The difference between burnishing and polishing may be briefly described as follows: While burnishing produces brilliance by pressing upon, or laying flat, the surface of the metal, polishing produces it by removing the projecting particles.

*(To be concluded.)*

**International Standardisation.**—In the *Electrical World* of June 24th, an interview is reported with Mr. C. le Maistre, general secretary of the International Electrotechnical Commission, who is on a visit to the United States as representative of the Electrical Section of the British Engineering Standards Committee. Mr. le Maistre has visited the principal electrical manufacturing centres of the United States, the Bureau of Standards of the Dominion of Canada at Ottawa, and the City of Montreal; he attended a meeting called by the U.S. Bureau of Standards at Chicago, and visited the Underwriters' Laboratories, and was to read a paper on "Standardisation" at the annual meeting of the A.I.E.E. in Cleveland at the end of June. At the request of the *Electrical World*, he described the activities and achievements of the British Engineering Standards Committee, and stated that, with the specifications that were to be issued, the ratings of American and British machinery would be comparable. Mr. le Maistre could not adequately express his gratitude "for the extraordinary generosity and courtesy he had received from one and all" with whom he had come into contact.

## CENTURY SINGLE-PHASE REPULSION-INDUCTION MOTORS.

THE Century Electric Co., of St. Louis, U.S.A., has devoted its activities for many years entirely to the development of single-phase apparatus, and has built up a large business on this basis. Its principal product is a line of single-phase constant-speed motors, on which the energies of a staff of expert designers have been concentrated, with the result that a type of motor has been evolved which possesses valuable all-round characteristics, the aim having been to produce a motor which should combine with the good starting qualities of the D.C. motor the excellent running characteristics of the pure induction motor. The "Century" motor is self-starting on full load, without the use of any external starting device other than a knife switch, coming up to speed quickly, and is capable of carrying 50 per cent. overload, with high efficiency and power factor. It is illustrated in figs. 1 and 2, and we give below some particulars of its construction and running characteristics.

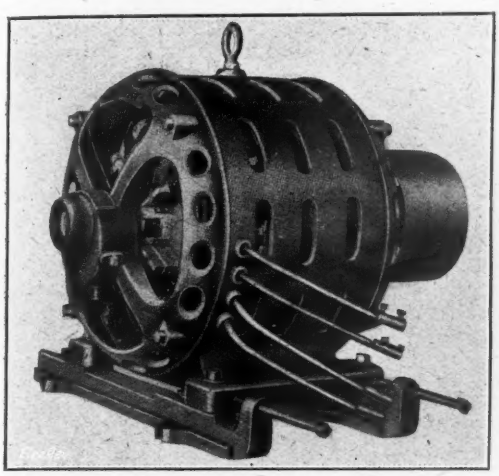


FIG. 1.—"CENTURY" SINGLE-PHASE MOTOR OF 30 H.P.

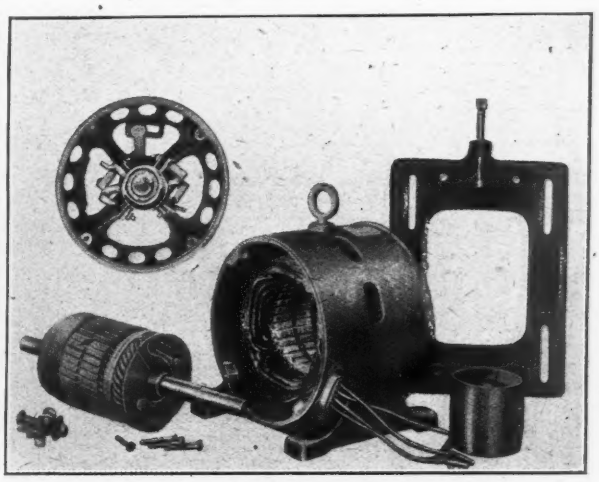


FIG. 2.—PARTS OF "CENTURY" MOTOR, 2 H.P.

The stator has a laminated toothed core with a pyramidal winding, and is connected to the supply circuit; the rotor has a progressive winding, connected to a radial commutator, which is in use only during the starting period, the brushes being lifted and the rotor winding short-circuited after the rotor has attained a predetermined speed. The motor, therefore, starts as a repulsion motor, without compensating or auxiliary windings, and when it has run up to speed it operates as a simple induction motor with the equivalent of a squirrel-cage rotor. By this means the highest possible starting torque is secured, together with the most efficient and steady running qualities.

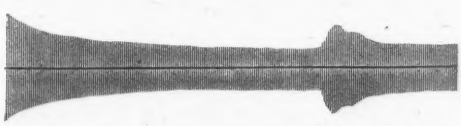


FIG. 3.—OSCILLOGRAM OF STARTING CURRENT.

The machine has been greatly improved during the last 16 years in both its electrical and its mechanical details, and it is claimed that it compares very favourably in starting qualities with the best types of D.C. and A.C. motors.

We give in fig. 3 an oscillogram showing the starting current of a 60-cycle "Century" motor of small size. From this it will be seen that the maximum starting current at the time of closing the main switch was about 250 per cent. of full-load current. This decreased to approximately normal in about one-third of a second, and again increased to a maximum of about 200 per cent. full-load current, being above the full-load current about the same length of time, as the motor changed from repulsion to induction. This second increase is due to the governor being adjusted so as to change the motor from repulsion to induction slightly below full-load speed, the motor then pulling up to speed as an induction motor. This curve is typical of all sizes when the motors are started with D.P. switches. In the larger sizes the governor is more closely adjusted, so that the motor acquires more nearly full-load speed before the governor operates, and as a result the corresponding increase in current is less in magnitude. If the governor were adjusted so that it operated just at full-load speed, there would be no increase of current due to the change from repulsion to induction operation.

As to the operating characteristics, a recent test on a 5-H.P. 50-cycle stock motor, carried out by the Testing Department of

the Manchester Corporation Electricity Department, gave the following results :—

The motor ran at 1,460 R.P.M., and was arranged for supply at either 208 or 416 volts. The starting current, at 412 volts, was about 36 amperes under all conditions of load, and the motor started against any torque not exceeding 250 per cent. of full-load torque; it would run up to speed against any torque less than 150 per cent. of the full-load torque. It continued to run as an induction motor with any torque less than double normal full load. The temperature rise, as measured by the resistance of the stator winding, after 6 hours' run at 5 B.H.P., was 75° F., and after 6 hours' run at 6·25 B.H.P., 95·5° F. The efficiency, power-factor, &c., are shown in the accompanying curves, fig. 5.

The motor is well adapted for driving apparatus which requires large starting torque, such as pumps starting under full head, air compressors starting under maximum pressure, rock crushers which are equipped with the necessary fly-wheel, bakers' machinery where the tub is full of dough ready for mixing, meat choppers, coffee mills which have been stopped with the burrs full of coffee, &c., not requiring a starter; the motor is also suited for operating vacuum cleaners, pumps which are controlled automatically, sewage-disposal pumps, organ blowers, and heating and ventilating apparatus, because it can be started from a distance, and starts quickly; and the brushes being removed from the commutator after attaining speed, motors of this type run very quietly.

The installation cost of the "Century" single-phase motor is less than that of a two- or three-phase motor of the same size, the polyphase motor requiring at least three wires, and the transformer costs averaging about 30 per cent. greater for the polyphase than for the single-phase repulsion-start motor. The transformer losses also are about 25 per cent. greater for the polyphase installation than for the repulsion-start induction-motor installation.

Large stocks of these motors in sizes from $\frac{1}{10}$ to 40 H.P. are carried by the Swedish General Electric, Ltd., who are the sole agents for the Century Electric Co. in Great Britain.

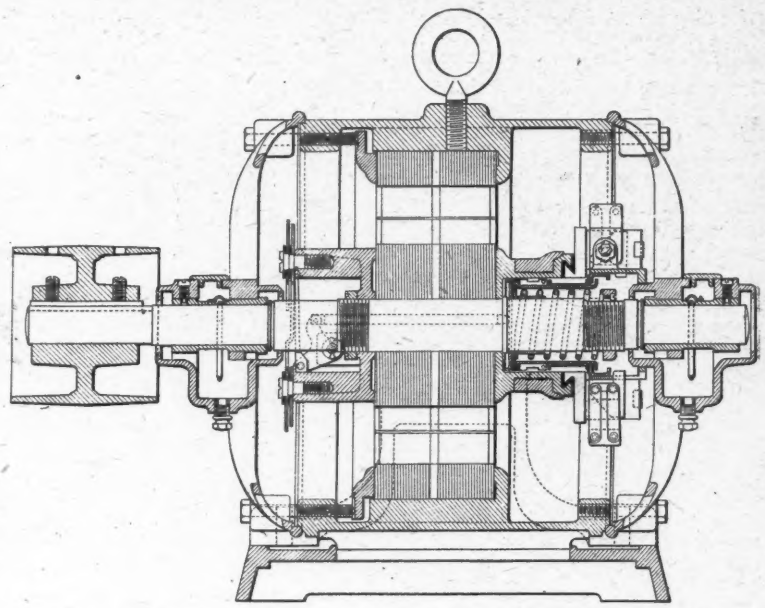


FIG. 4.—SECTION OF "CENTURY" MOTOR, SHOWING THE GOVERNOR AND SHORT-CIRCUITING DEVICE.

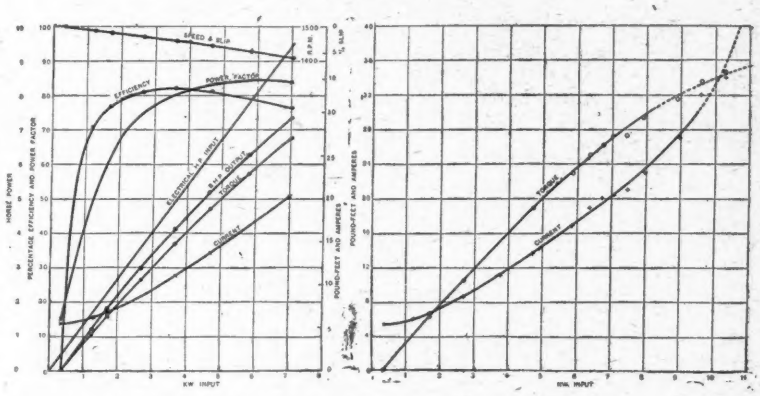
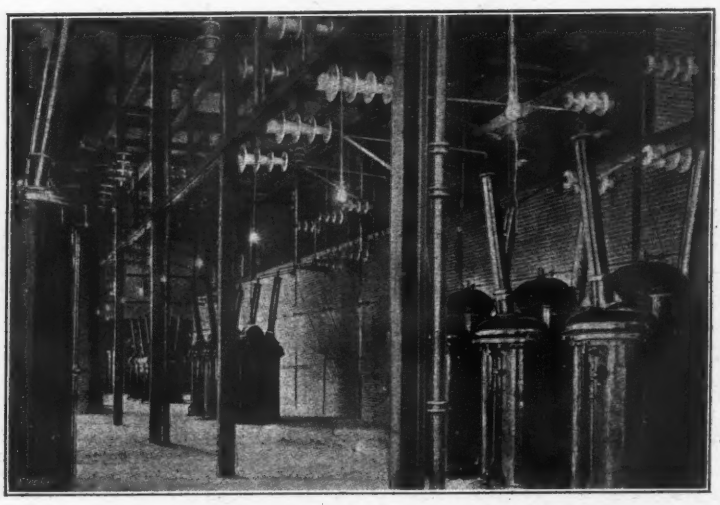



FIG. 5.—CHARACTERISTIC CURVES OF "CENTURY" MOTOR.

## REPORT OF THE HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO.

THE eighth annual report of the Commission, covering the year ended October 31st last, with its 460 pages and numerous illustrations, constitutes an exceedingly bulky volume, and a record of which our Canadian friends may well be proud.



110,000-VOLT SWITCHES, NIAGARA TRANSFORMER STATION EXTENSION.

During the year the attention of the department has been given to the Eugenia Falls development and to acquiring land for the additional line from Niagara Falls to Dundas. About 400 miles of L.T. line have been completed, and permission had to be acquired for about 400 crossings of railways, telegraphs, &c. The possibility of obtaining an additional supply from Niagara, making use of the total difference in level between Lakes Erie and Ontario, is being considered.

Agreements were entered into with 32 municipalities; with the Union Carbide Co. for an additional supply of 8,000 H.P.; with the Interurban Power Co., of Toronto, for the supply through the Toronto hydro-system of 3,000 H.P.; and owing to the supply of contract power from the Ontario Co. becoming exhausted, a temporary contract was entered into with the Toronto Power Co. for the supply of 16,000 H.P. A lengthy summary is given of the extensions carried out at the various plants supplied by the Commission, and a total capacity of 236,725 K.V.A. of transformers are now installed or ordered for the various stations.

At October last, there were completed or under construction 1,143 miles of secondary transmission lines of from 46,000 to 2,200 volts; some 45,000 wood poles were used, and 996 miles of single-circuit telephone line has been erected for operating purposes.

Only two total system interruptions occurred in the year on the Niagara system, each of momentary duration. Electrical storms occurred on 49 days, the majority in certain specific areas. Not a single failure of the H.T. line occurred, and insulator trouble appears to have been eliminated. The 162,000 suspension and strain units on the original line sections were tested twice for dielectric strength. There are now three

separate circuits of steel reinforced aluminium cable between Dundas and London, with the exception of the Berlin-Stratford section.

The electrical and mechanical equipment of the H.T. and L.T. stations gave practically no trouble, due to rigid inspection and monthly tests of insulating oil, &c.

Inductive trouble on the private telephone system has been successfully overcome by a new type of protective apparatus, including an insulating transformer designed by the telephone inspector.

The capital invested in the Niagara system totals $8,824,549; the income for the year was $1,506,280, and surplus available for sinking fund and depreciation $239,629.

In addition to the above, the Commission operates the St. Lawrence, Port Arthur, Severn, and Wasdells Falls systems, and others are being developed, including the Eugenia and Muskoka systems.

The total capital expenditure on all these projects, including stock, tools, &c., of the Commission totals $12,582,221.

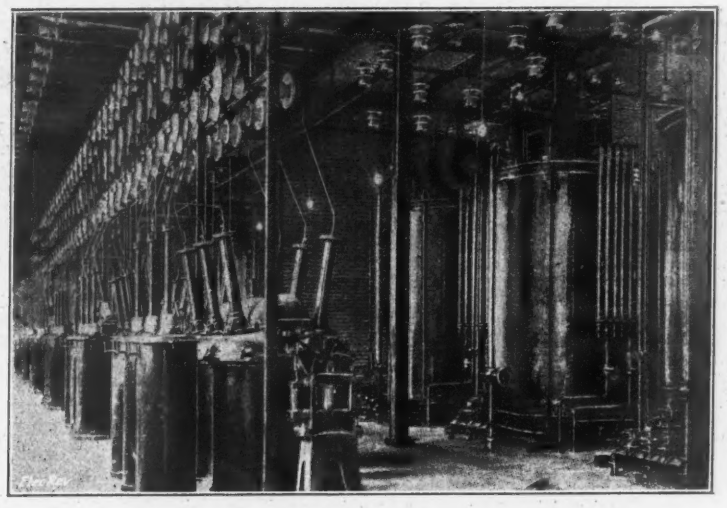
During the year assistance and expert advice was given to a number of municipal authorities, and contracts for the supply to the Canadian Pacific Railway's McNicoll terminal of 800 H.P., National Portland Cement Co., Durham, of 1,300 H.P., and the Canadian Cement Co., Shallow Lake, of 800 H.P. were submitted.

In a number of instances, the street lighting systems have been reorganised, using larger metal-filament and in some cases nitrogen-filled lamps.

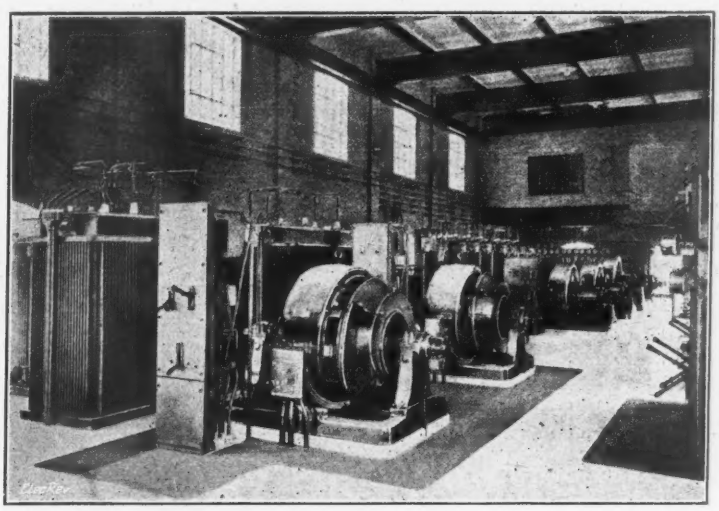
A financial summary relating to 99 municipalities supplied by the Commission in 1915 shows a gross surplus, after meeting debenture and interest charges, for the year of $702,540, or less depreciation, of $461,896. The number of lighting consumers was 117,010, and of power consumers 3,818, making a total of 120,828 consumers. The KW.-hr. varied in cost from 11.5 c. to 2.4 c. for domestic use, and from 12.2 c. to 1.9 c. for commercial use, the average figures being 3.9 c. and 3.1 c. respectively.

The municipalities have invested $17,683,000 in distribution systems and equipment, with a fixed debt charge of $814,443 per annum.

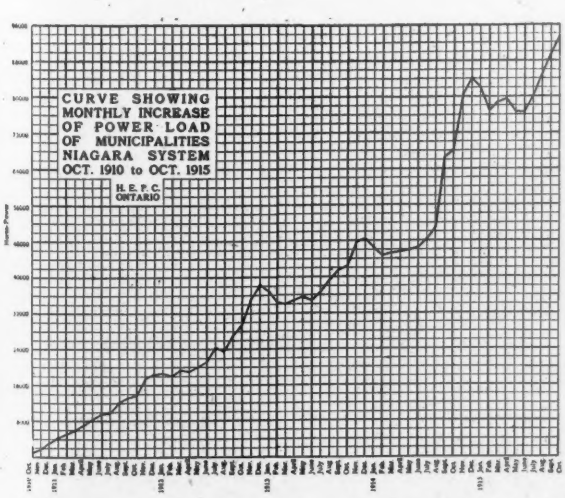
The report says: "Bearing in mind that these fixed charges include the sinking fund and debenture retiring payments as well as interest, so that the present consumers are not only paying the ordinary operation, maintenance, and interest charges, but are retiring about 3.3 per cent. of the capital debt each year, thus automatically providing for depreciation regardless of any special provision which may be made in the accounts, the phenomenal success of the enterprise from the municipal standpoint is apparent."



46,000-VOLT SWITCHGEAR AND TRANSFORMERS, NIAGARA TRANSFORMER STATION.



ROTARY CONVERTERS, &C., LONDON SUB-STATION.




NIAGARA SYSTEM LOAD CURVE, ONTARIO H. E. P. COMMISSION.

The various undertakings are under the supervision of nearly 50 inspectors appointed by the Commission, and some 340 municipalities are dealt with.

The Commission maintains a purchasing department whose services are offered to any municipality in Ontario, whether connected with the hydro system or not, and during the year over $500,000 worth of goods, &c., have been purchased in this way for 132 municipalities.

It is stated that savings of from 5 to 50 per cent. have resulted in cost through the co-operative buying, which is carried out by an expert staff, having the use of equipment for standardising and testing. The officials of the Commission also render assistance in formulating business campaigns, for which complete data has been collected, and a number of municipalities have benefited from this service.

*Farm Power.*—The report contains data relating to the use of a syndicate outfit and domestic electric supply by a group of seven farmers at Waterloo. The outfit consists of a 20-H.P. induction motor with auto-starter mounted on one wagon and transformers and a standard 3-phase meter mounted on another.

Two services are run to each farm, one a domestic supply and the other a 2,200-volt service for the syndicate outfit, terminating at a point where it is only necessary to use 75 ft. of portable cable to connect the transformers with the motor.

The domestic uses consist of lighting throughout, and the use of irons, washing machines, and one or two pumps. Six of these consumers (outside the town) used 1,869 KW.-hrs. for domestic purposes, and the seven (including one in the town) used 7,203 KW.-hrs. through the syndicate outfit, making a total for the seven, one of whom had no lighting, of 9,072 KW.-hrs. The bills of the six consumers using both power and light varied approximately from $70 (£14) to $100 (£20) per annum, the average cost per KW.-hr. being from 5 to 6.5 cents (2½d. to 3¼d.).

The syndicate outfit was used for silo filling, threshing, sawing, and chopping; usually from 2,000 to 4,000 bushels of grain were threshed per farm.

*Electric Railway Projects.*—The Commission has carried out a number of preliminary surveys of electric railway projects

(since the passing of the Hydro-Electric Railway Act) covering some 2,000 miles. After consideration, it has been decided to adopt the 1,500 or 3,000-volt direct-current system on such lines, and plans have also been prepared for a standard 60-ft. three-compartment steel car. The London and Port Stanley Railway was constructed and equipped under the supervision of the Commission.

A section of the report deals with the work carried out by the testing and research laboratories, which covered tests of line material, switches, and other goods, largely made for the purchasing department, but in some cases with a view to improving manufacturers' products. The statement is made that the only suitable instrument on the market for the measurement of excess power (*i.e.*, energy consumed in excess of a certain predetermined "firm power") was of foreign manufacture, and efforts are being made to find a suitable substitute of home manufacture.

Tests were carried out on cooking stoves of six different makers, and curves made of temperature and energy consumption, and from the data obtained the comparative costs of doing various classes of cooking were calculated.

In the lamp laboratory a great many tests were carried out; the report states that gas-filled street series lamps have entirely replaced the vacuum series lamp, and are rapidly replacing all arc lamps except the most improved (luminous arc) type.

The illumination laboratory, amongst other work, carried out a test to ascertain the extent of fire risk when using gas-filled lamps in show windows, and certain limits have since been imposed by the inspection department as a result. The photographic department supplied about 10,000 prints during the year, and filed 2,000 new negatives.

The report concludes with a lengthy section on hydraulic investigations, and contains a reference to the preliminary surveys carried out in connection with a possible scheme for utilising the unallotted surplus of water available at Niagara, with an effective head of not less than 300 ft.

The report is, as usual, an instructive commentary on the progress of the Hydro-Electric Commission's undertaking; if it lacks anything to our eyes, it is in the absence of any general indication as to the classes of consumers being served. To judge of the merits of an undertaking, one needs a comprehensive idea as to the conditions obtaining in the area of supply.

## WAR ITEMS.

**Entertaining "Tommy."**—Quite recently the girl workers of Pope's Elasta Lamp Works, at their own expense, entertained 120 wounded men at the Shepherd's Bush Empire. About a fortnight later, the same girls gave a tea and outing to another 60 men in Kew Gardens, and those who could not join the party received cigarettes at the hospital. A third event is now being arranged for, and another 60 wounded soldiers are to be taken to Kew Gardens to a similar treat.

**Export Prohibitions.**—A special and bulky Supplement to the Board of Trade *Journal* for July 13th gives full information respecting prohibitions of export in force in British India, the Self-Governing Dominions, Egypt, and certain other British possessions.

**To be Wound-up.**—The Board of Trade has ordered the following companies to be wound-up:—

Plutte Scheele & Co., Ltd., 18-19, Queenhithe, London, E.C., merchants and agents for electrical goods. Controller: G. W. Roberts, 133, Wool Exchange, Coleman Street, E.C.

Leeds Meter Co., Ltd., Tower Works, Armley, Leeds, water meter manufacturers. Controller: W. Simpson, 19, Bond Street, Leeds.

Kirchner & Co., 21-25, Tabernacle Street, London, E.C., wood-working machines, &c. Controller: J. Fraser, 31, Copthall Avenue, London, E.C.

British Hulm Metallic Packing Co., Ltd., Snowdon's Wharf, Milwall, London, E., manufacturers of metallic packing for steam engines, &c. Controller: J. E. Wilson, 28, Basinghall Street, London, E.C.

Poldi Steel Works, Sheffield, steel manufacturers. Controller: A. D. Barber, High Street, Sheffield.

A. Barson & Co., 57, Scrutton Street, London, E.C. Engineers' tool manufacturers. Controller: A. Turquand Young, 41, Coleman Street, E.C.

The Board of Trade has revoked the order winding up Phonotas Co., Ltd., London, W.C., sanitary system for cleaning telephones.

**Exemption Applications.**—At Southwark Tribunal, Mr. B. E. White, electrical engineer, in applying for exemption, stated that before the war he employed between eight and ten men, but now had only a man and a boy left. He had to work double time himself on repairing electrical motors. He was granted conditional exemption on joining the Volunteer Training Corps.—The Imperial Lighting Co. (Implitico, Ltd.), electric sign contractors, applied for the exemption of a general and electrical engineer. Out of 42 hands before the war, 12 had joined up, and they had only one engineer left out of eight. He was the only man in the machine shop, where they had a number of boys and girls at work. He was granted three months' extension on joining the V.T.C.

At Battersea, Mr. Pope, trading as F. Williams, electrician, appealed for total exemption. He said he was a contractor for electric lighting, bells, motors, &c. He had been in business ten or twelve years. His partner was in the Army, and he allowed him 10s. a week, and did all the work himself. He was allowed a month's final extension.

Before the Hastings Tribunal, Mr. H. Blackman, of Messrs. Upfield & Son, appealed for Mr. R. H. Pattenden, electrical contractor. He could not get anyone over military age as a substitute. Two months allowed.

Conditional exemption has been granted to Thos. C. Palmer, electrician at Hadham Hall (Herts), the seat of Mr. Wm. Minet.

Nantwich Tribunal has conditionally exempted, on the appeal of Baroness W. Schroder, the electrician at her Red Cross Hospital at Stapeley House, where he has been engaged for some years. The Military assented.

At Stratford-on-Avon, the Electricity Co. appealed for A. R. Bailey (24), technical clerk and responsible person when the manager was absent. The Military did not assent, contending that appellant's work could be done by a man over military age. As appellant had been rejected, a fortnight was allowed for him to go before the Army Medical Board.

Mr. G. Miller (40), assistant electrician at the Haggerston Military Hospital, Berwick-on-Tweed, has been given exemption.

At Deal, Mr. R. M. C. Strebbins, electrician, who is a member of the Society of Friends, appealed as a conscientious objector, and was granted conditional exemption on joining the Friends' Ambulance Unit.

Mr. A. R. J. Creasey (31), manufacturer of electrical switchboards, of Herne Bay, who was refused any exemption by the local Tribunal, appealed to the East Kent Appeal Court on July 12th. The appeal failed, and Mr. Creasey was refused leave to go before the Central Tribunal on the ground that he was not engaged in a reserved occupation as an engineer.

At Reigate, on July 11th, Mr. Makovski, of Messrs. Tamplin & Makovski, electrical engineers, applied for exemption for their inside manager (Mr. H. Francis, 27), who also appealed on personal and conscientious grounds. The case had been adjourned for a medical examination, and it was announced that Mr. Francis declined on conscientious grounds to be examined. The Tribunal refused exemption, and it was announced that Mr. Francis would not be called up for a month

Newcastle-under-Lyme Tribunal has given three months' exemption each to two employés at the Corporation electricity works.

Mr. S. Terry (28), electrical engineer, of Canterbury, applied for an extension of his three months' exemption, and also for an employé named Elliot (38), engaged in wiring work. Mr. Terry contended that he was serving national interests as he was carrying out important contracts. Each was allowed six months.

Broadstairs Tribunal granted conditional exemption to several employés of the Isle of Thanet Tramway Co., on the ground that they were engaged in work of national importance. The Military assented.

At Southend-on-Sea, an electrical engineer (35), for nine years in business, appealed on the ground that military service would mean the closing of the business. He said that he had only two youths to assist him. Final exemption until August 1st was allowed.

Hemel Hempstead Tribunal has given conditional exemption to Mr. J. McDermot, manager of the electrical department of Messrs. Dickinson & Co., and three months to A. J. Young (27), the firm's electrician.

Conditional exemption has been conceded, at Bath, to G. N. Slipp (22), stoker at the electric tramway works, and to F. Gilham (30), a brakesman with the Tramway Co.

At Maidenhead, Mr. W. Hogarth Vevers, jun. (26), electrical engineer, responsible for the business of Messrs. W. H. Vevers & Son, has been exempted until October 1st, on condition that he joins the Volunteer Training Corps. Similar exemption was conceded to Mr. W. L. Chubb, assistant engineer and deputy-manager of the electricity works; and until January 1st to Mr. W. H. Arundell, electrician, who is "badged."

Maidstone Tribunal has given conditional exemption to T. Cooker, driver on the Corporation tramway staff, who has served 17 years in the Army; and has given until September 19th, by which time it is expected they will receive the pink form, to seven other drivers, the chief clerk and stores superintendent, a turner and engineer, and an inspector on the tramway staff.

At Watford, a certificate of conditional exemption has been granted to Mr. J. W. Russell (32), electrical fitter.

Maidstone Tribunal has given two months' respite to Mr. A. Leach (36), electrical engineer, to produce proof that he is an American subject.

Settle Tribunal has given conditional exemption to Mr. C. A. Copinger, engineer and manager to the Bentham Electric Supply Co., Ltd.

At Clayton-le-Moors, exemption until the end of September, with leave to appeal further, was granted to an electrician, aged 32, on condition that he joins the Volunteer Training Corps.

At Amersham, on July 9th, Mr. S. Beeson (26), electrician, of Chalfont St. Giles, appealed on the ground that he was running his business single-handed. Dismissing the appeal, the Tribunal requested the Military to delay the calling-up for a month.

When the Imperial Tramways Co. asked the Middlesbrough Tribunal for the exemption of a coach-painter employed on the Middlesbrough, Stockton and Thornaby system, Mr. A. E. Forbes (solicitor), described the man as absolutely indispensable for keeping the cars in proper order. Six thousand munition workers were conveyed to and fro on Teesside on the company's system, and an inspector who recently went over the company's premises for the purpose of "combing out" had not taken a man. The Tribunal announced that as the coach-painter was not indispensable to the running of the cars and was of Army age, the appeal would be dismissed.

At Farsley (Yorks.), the Morley Electrical Engineering Co. appealed for a foreman armature winder and electrician, aged 25, and for a turner, aged 35. Mr. Summerscales, a member of the firm, spoke of the value of these men, in that at the present time it was practically impossible to get men in these trades. They were in use in "controlled" establishments, who would not give them leaving certificates. Conditional exemption to September 30th was granted.

Temporary exemption till October 31st has been granted, at Rochdale, to Mr. G. L. Adamson, who appealed for Mr. F. Rothwell (manager) and Mr. A. B. Hopkins (electric fitter).

At Southport, John Ainscough, who said he was a munitions "case worker" in the employ of Messrs. Schofield & Wright, electricians, appealed on the ground that he had bad health, and also that it was in the national interest that he should remain in his present occupation. He said he would be 41 years of age within a week. The appeal was adjourned so that appellant might go before the Medical Board.

At St. Annes, Mr. H. W. Laing, manager of the Blackpool, St. Annes and Lytham Tramways Co., Ltd., appealing for two motor-men and a foreman of the track repairing staff, said that out of the traffic staff of 125 he had lost 110 men. Conditional exemption granted.

**Enemy Aliens at Birmingham.**—Birmingham Chamber of Commerce has adopted the following resolution in reference to enemy aliens:—

That all members of the Chamber of enemy origin, who have not become denationalised of their enemy origin and have not been naturalised in the British Empire for at least 20 years, are requested to resign their membership. This applies also to limited liability companies or firms whose share capital is held to the extent of one-third or more by persons of enemy origin, and to limited liability companies one-third or more of the directorate of which are held by persons of enemy origin.

**Australia and Enemy Shareholders.**—A Reuter dispatch from Melbourne states that the Minister of External Affairs will shortly take legal action against the companies incorporated in Australia which have not complied with the precautionary regulations rendered necessary by the war regarding enemy shareholders.

**Some Carville Resolutions.**—At a well-attended meeting of the employés of the Newcastle-upon-Tyne Electric Supply Co., at Carville Power Station, the following resolutions were carried unanimously:—

1. That this meeting considers it the duty of the State to provide adequate pensions for all men (and those dependent on them) who are disabled in the war, and also for the widows and dependents of those killed, seeing that the men met with their death or received their injuries while serving the State.

2. Seeing that any advance in wages that the employés of the Newcastle Electric Supply Co. have received during the war is in no sense proportionate to the advance in the cost of living, we regret that we are not in a position to start a branch of the War Savings Association.—*Newcastle Journal.*

**Trading with the Enemy: Prohibitions.**—The "London Gazette," dated July 18th, contains further lists of bodies and persons with whom trading is prohibited in the following countries:—Argentina, Bolivia, Brazil, Chile, Denmark, Greece, Japan, Netherlands, Norway, Spain, Sweden, U.S.A., &c.; also variations in previous lists.

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**Breakdowns of German Plant.**—We recently quoted from the report of Mr. T. H. U. Aldridge, electrical engineer to the Shanghai Municipal Council, concerning the breakdowns of the A.E.G. turbo-generator plant installed at the Riverside power station. Our readers will be interested to learn that on June 18th, 1916, one of the 5,000-kw. alternators, which was only commissioned last year, broke down very badly. Some of the stator coils either short-circuited or went to earth, causing a very bad burn-out in part of the stator to such an extent that the copper conductors and the iron laminations became entirely fused together, whilst the insulation of half the end windings was completely burnt off. To repair this machine will take at least three months, and even then it is doubtful whether it can be regarded as a reliable piece of apparatus. Of the four A.E.G. turbo-generator sets at Riverside three have already seriously broken down. This sort of thing will damage the reputation of German manufactures very seriously in the Far East.

# LEGAL.

Tar Oil for Electricity Generating Plant.—Suffolk Electricity Co. and German Patent.

On Thursday last week, before the Controller, Mr. Temple Franks, and the Deputy Controller, Sir Cornelius Dalton, in the Patents Court, the Suffolk Electricity Supply Co., Ltd., applied for a licence to use a German patent in connection with their electricity undertaking for the town of Felixstowe. The patent in question was No. 4,908, of 1909, in the name of Konrad Aust, of Essenerstrasse 11, Berlin, for a mechanism for employing tar oil, instead of American oil fuel, in engines for generating electricity. It provides for an arrangement whereby, in an internal-combustion engine in which the fuel is injected by gas under pressure through an atomiser, a small portion of fuel is supplied directly to the admission port of the cylinder without passing through the atomiser, through a separate duct, this duct being cut off from the chamber only during the ignition period. The appliance is, in substance, an auxiliary pump which injects oil of lower ignition temperature in advance of the main fuel oil. It is by this means only that tar oil can be used for driving engines of the Diesel type.

Counsel explained that he understood that by this contrivance the temperature of the air was raised for the ignition period by a small injection of petrol, sufficiently to vaporise the tar. The Suffolk Electricity Supply Co.'s application was opposed by Messrs. Mirrlees, Bickerton & Day, Ltd., for whom Mr. Courtney Terrell appeared. Mr. Imry represented the patentee.

Opening the case for the applicants, Mr. Napier Prentice, their secretary, explained that firms with electricity-generating plant found very great difficulty to-day in obtaining supplies of American fuel oil. In addition to obtaining security of supply, the Suffolk Electricity Co. hoped, with the aid of this new device, to cut down their fuel bill by half. Manufacturers whom he had approached asked £363 for making and fitting this special appliance to two engines. He understood that it was because of the price fixed by the British licences from the Germans that the cost was not smaller than this. If the Board of Trade would give the Suffolk Electricity Supply Co. a licence for this auxiliary pump, he was confident that he could make and fit it for £60, all told, to two engines. For 112 tons of oil, which the company used last year, at the present price the cost would be £960. By using tar oil for a similar amount of work, the cost would be brought down to £576, a saving of £384 for fuel. But if it cost £363 to fit this apparatus for 470 h.p. to but two engines, it would hardly be worth while to makers of electricity, unless it were guaranteed that the war would last more than another year. The purchase of American oil was against the national interest to-day; it was to the national interest to encourage the use of tar oils in Diesel engines.

Mr. Terrell explained that the opponents, for whom he appeared, were the sole licensees under the patent in this country before the war. They paid a large sum for the licence—£1,500 down. They had the equipment and plans for making, and could meet the entire demand. If there was anything they could not cover, they were ready to issue licences to sub-licensees.

The Controller: I imagine the legal opinion as to your licence would be that it is suspended during the war. If it is so, we may treat your licence as non-existent. I am not sure you ought not to have come here to get a licence yourself.

Mr. Terrell: It may be that that is what we ought to do. We have either supplied, or contracted to supply, 22 firms with a total horse-power of over 4,000.

The Controller: You are the only people who can supply this improvement at present, and you can charge what you like. If you charge a reasonable price, I admit there is something to be said for maintaining your position. But the Board of Trade must supervise, and here comes the opportunity for us to exercise that oversight.

Mr. Terrell then called as witness Mr. Charles Day, managing director of the opposing firm, who said that on November 29th, 1912, they entered into agreement with the patentee by which they paid £1,500 in cash and agreed to pay a royalty of 2s. 6d. per horse power on all engines fitted. They experimented to ascertain how many varieties of tar oil could be used with these engines, and had to set up an installation for distilling tar oil. In the beginning they found great difficulty in getting tar oil. They engaged a chemist who had been chemist for a tar distillery, and had to use their distillery for the supply of tar oil to their customers. Including payment for the patent, their preliminary expenses came to £3,000. In their price they added the 2s. 6d. royalty for the patentee and 2s. 6d. for themselves towards a sinking fund to recoup themselves for this preliminary outlay. The prices of fuel oil began to creep up a year after the outbreak of the war. They had been from £3 to £4 a ton. In January last they were £8 to £9. Tar oil cost £3 or £3 10s. Mr. Prentice said he hoped to get it at £4. It varied according to the district. This complicated and delicate piece of apparatus required considerable skill to install. Personally, he should object to any stranger fitting it to an engine he had anything to do with. The £360 price cited was not unreasonable. His firm were pioneers in this matter, yet they had not had an inquiry from the company. To everyone who made this type of engine they had offered a licence to make this special apparatus, with the benefit of their experience as to details of manufacture and drawings. These auxiliary pumps had to be watched after fitting, and taking into account all the risks the manufacturer ran, the price was not excessive.

The Controller: Don't you think that, like so many more people in a similar situation, you were rather "done" by this agreement?

MR. DAY said: Not at all.

The CONTROLLER: I have seen agreements here that have absolutely astounded me that anybody could enter into them.

Asked by MR. TERRELL as to the possibility of the Suffolk Electricity Supply Co. making this apparatus, MR. DAY replied that he would not speak of its possibility, but he would speak strongly against its desirability.

Called on behalf of the opponents, MR. HUGHES, of Messrs. Willans & Robinson, Ltd., Rugby, said he thought Messrs. Mirrlees, Bickerton & Day's prices were reasonable and fair. His own firm at Rugby built the Suffolk Electricity Supply Co.'s engines, and they had now practically concluded arrangements to receive a sub-licence from the Stockport firm.

MR. DAY: As to Mr. Prentice's hopeful figure, with several sets going through at the same time, the apparatus would cost £150.

The CONTROLLER (to Mr. Prentice): How did you make up your £60 for fitting two engines?

MR. PRENTICE: It is quite a simple affair—£10 for making the pump, £10 for fitting to the engines and running the pipes to the valves, and £10 for sundries—a small distributor, &c. It is nothing more than a pipe conveying the tar oil to another position. I simply want to put the oil in position to enter in advance of the main charge, and that I can quite easily do for the sum I have mentioned.

MR. DAY: Mr. Prentice apparently proposes one pump for three cylinders. One is needed for each, according to our experience.

The CONTROLLER, in announcing that he would report on the hearing to the Board of Trade, suggested that the electricity company might like, if the makers of their machines were receiving a sub-licence, to get into communication with them.

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NEWALL *v.* ELECTRO-FLEX STEEL CO., LTD.

IN the Chancery Division, on Friday last, Mr. Lavington, on behalf of the plaintiff in this debenture-holder's action, applied to Mr. Justice Astbury for the appointment of a receiver and manager of the defendant company. Counsel said the debentures had become payable on the ground that the company had passed a resolution for voluntary winding-up. That alone made the debentures payable, and there were other conditions that had not been complied with. The company consented to the application. The company was doing work of national importance, and it was important that it should be continued, and he asked leave for the receiver to borrow moneys up to £5,000. The company had to purchase machinery and plant, and money was also required to pay wages.

His LORDSHIP appointed a receiver and manager, but referred the application for leave to borrow £5,000 to Chambers, remarking that it was a very large sum to empower the receiver to borrow. He, however, in the meantime, gave leave to borrow £500 for wages.

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COX-WALKERS, LTD., *v.* S. DIXON & SON, LTD.

AT the Richmond County Court, plaintiffs, of Darlington, sued defendants, electricians, of Leeds, for the sum of £16 18s. 2d., for goods supplied at the Richmond Camp. According to the *Yorkshire Herald*, it was stated that the parties had contracts for laying down electric mains at the Camp, and, as the defendants ran short of materials, the complainants let them have a quantity on the understanding that they would be replaced. Since then the prices of certain articles had gone up considerably.

His Honour, JUDGE TEMPLER, said he believed the story of Messrs. Cox-Walkers that the goods had to be replaced, and not paid for at cost price. The prices had gone up considerably since the arrangement, and it was not right for the complainants, who had obliged the defendants, to lose by it. He gave a verdict for the plaintiffs, with costs.

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MADRAS ELECTRIC SUPPLY CORPORATION, LTD.

IN the Chancery Division, on Tuesday, Mr. Justice Astbury confirmed a reduction of capital of this Corporation by writing off £2 per share from the ordinary shares. The preference shareholders, Mr. Chinnery stated, were to give up last year's dividend, and were to take it in fully-paid shares. In an affidavit, the chairman said the installation in Madras became very defective, and the result was that they were unable to make any profit out of it. But new plant had been erected, from the issue of further shares and debentures. The plant was now in full working order, and last year they made a substantial profit; the company wished to take advantage of the improved prosperity to write off the balance of loss.

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**French Industries.**—A central association has been formed in France to facilitate the resumption of industrial activity in the districts at present in the hands of the enemy, when the latter have been expelled. It will devote itself to the re-establishment of plant and stocks, and of labour, to hastening payment for goods requisitioned and indemnities due to industrial concerns, and to facilitating the raising of loans to enable manufacturing operations to be resumed as quickly as possible. The association embraces all kinds of industries, and will co-operate with other trade groups and associations to prevent waste of effort.—*La Revue Electrique.*

## REVIEWS.

*Examples in Magnetism.* By Prof. F. E. AUSTIN. Published by the Author. Price $1.10, in U.S.A.

From a perusal of other works by the same author we are led to expect a high standard of practical value on taking up this book. Nor are we disappointed in the outcome. The text is arranged in the form of a dozen "lessons," in each of which several topics are dealt with along the following uniform lines: First there is stated an example designed to bring out the desired points. The laws bearing on the matter are explained briefly, and the algebraic or symbolic expression of them is given. The known data are tabulated systematically, and the complete solution is worked out, each step being explained. Next there is given a problem resembling the example which it follows. The answer to this problem is given, so that the reader can test his understanding of the instruction imparted by the example. Finally, there is a second problem dealing with some other phase of the same subject. No answer is given to this problem, and the student is thus left to apply the principles illustrated by the example in a different manner, and also to devise a means of checking his result. The author then proceeds to the next topic, and, since the topics themselves are well arranged, it will be seen that the reader who works conscientiously through this volume is well equipped to deal confidently with any magnetic problem or its application.

The author attaches special importance to a clear understanding of the principles of mechanics, and certainly does his best to help the reader to this end. The first lesson is devoted to a brief explanation of trigonometrical ratios and relationships, and includes a handy collection of formulæ relating to trigonometrical functions of the sum and difference of angles. Trigonometric solution of triangles and the resolution and composition of forces form the bulk of the second lesson, and there then follows a statement of symbols, notation, English and metric units, equivalents and definitions, all arranged so as to be convenient for reference. The force of gravity, moments, and couples being dealt with in Lesson IV, the reader has by this time a knowledge of the fundamental principles and methods of trigonometry and mechanics, as required for the solution of magnetic problems. The general nature of magnets, magnetism, fields of force (magnetic and otherwise), and magnetic poles are then explained, and the next lessons are devoted to elementary calculations concerning the force between magnetic poles and between magnets suspended in various ways. The components of the earth's magnetic field and their bearing on various magnetic problems are next considered; then the resultant field due to two poles; and the restoring couple on a magnet deflected in the earth's field. Further examples on magnetic moment, pole strength, and the investigation of the earth's field and its effects follow, and it is worth noting that the author has so designed and framed his problems as to make them very instructive and of much more interest to the reader than the purely academic problems which are so often used to depress the student of this subject. The concluding lesson deals with the comparison of strengths of magnetic fields, and includes a collection of pithy paragraphs containing useful information regarding the materials and properties of magnets, and methods of mapping magnetic fields. The book is very well indexed, and is thoroughly useful as a work of reference, whilst the large number of examples and problems make it very suitable as a text-book either for class tuition or private study. Considering the cost of setting up the numerical examples, the price of the book is not excessive.

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*The Electric Railway.* By A. MORRIS BUCK, M.E. London: Hill Publishing Co. Price 12s. 6d.

This book is stated by the author's preface to be intended as a text-book for the instruction of advanced students who may be assumed to have a fundamental knowledge of mechanics, to have taken power plant and transmission line work as independent courses, and who wish to specialise in electric traction. United States students are meant, but there are now similar facilities in various British centres, and a distinct demand exists for such a specialised text-book as the author aims at.

The first chapter starts with a statement of the importance of transportation as a necessity of economic development and civilisation, and a short historical account is given of the trunk-line railroad and of the street railway in its various stages. Electric systems are classified by the characteristics of the motors used under three heads: direct-current series wound, single-phase alternating current, and three-phase alternating current. A brief statement of the advantages of electric systems follows, winding up with the statement that the superiority of electric power is great enough to warrant its consideration for any class of railway service, and that its use is the more desirable almost in proportion to the density of the traffic.

The Mechanics of Traction dealt with in the second chapter shows first how the secondary units used for the solution of problems relating to the motion of trains have been derived from the elementary laws of motion, and then defines the components of train resistance. Dealing with gradient resist-

ance, it is suggested that the tangent of the angle of inclination to the horizontal, which is the surveyor's gradient, differs so little from the sine of the angle, which is the resistance factor, that for practical calculations the former may be taken. It might be added that the tangent factor gives a margin on the safe side for the power required, but that when the gradient approaches the limits for adhesion working the difference becomes important. This is, perhaps, outside railway work.

The speed-time curve is next considered, and the superiority of this curve over the alternative distance-time or acceleration-time curves in respect to the information afforded is pointed out. The method of plotting it from given data is gone into with considerable thoroughness, following Mr. Mailloux's well-known paper on the subject, in which the characteristics of the motors to be employed are the principal data. This is hardly the most logical course. What one really has to discover in a practical case is the motor equipment needed to run trains of a given capacity at various speeds, and from that investigation to derive the most economical speeds and equipments. In practice, too, the investigation has to be made for a whole route, not only for the individual runs making up the route, and though it is true that an equipment which will make the most difficult individual run at a required schedule speed will give at least that speed over the whole route, it is also true that it may be more economical to use a smaller equipment, and to calculate on the speeds of the individual runs varying with their ease or difficulty, as always happens in practice.

Chapter III describes and classifies the various types of motors used or available for railway work, first by the character of the current supply and the motor structure, and, secondly, by their performance characteristics. The recent return to field-control of speed made possible by interpole construction is duly noted. All the discussions of motor performances and efficiencies are qualitative and general, excepting as regards the characteristic curves, which are figured; and, further, a good deal of general knowledge of the principles and technicalities of motor action is taken for granted. Subject to these remarks, the treatment of alternating-current motors in their different varieties is quite good, but it will not take the place of more specialised treatises, or help the designer.

The chapter on motor construction is slightly historical and otherwise confined to the mechanical arrangements and materials of construction in the various classes of motors.

The chapter on control arrangements is an excellent one, giving sufficiently detailed explanations of the principles of action and their practical application for the various supply and motor schemes in use, including single and three-phase equipments, with a brief notice of phase-splitting and rectifying devices for obtaining continuous from alternating current.

The determination of power requirements from the elements of speed-time curves, train resistance, and gradients is dealt with in a satisfactory way, mostly by graphical methods. The use of the polar current-time diagram (adapted by Mr. Mailloux from Dr. Fleming's *Alternate Current Transformer*) is given deserved prominence for obtaining the R.M.S. value of motor loads. Braking is dealt with in a chapter to itself, much more fully than usual.

The chapter on "Cars and Car Equipment" is necessarily rather mixed in subject, including collectors, lighting, heating and other auxiliaries, but it contains a description of the different types of passenger car, the seating and door arrangements, their relative advantages and drawbacks, which is both unique and of high value. Traffic managers will find some good information, representing the cream of American experience, on this important matter. The design of trucks and electric locomotives is gone into with considerable fullness, with a fair warning that finality in such design has not been attained.

The track has little space devoted to it, the treatment being merely descriptive. It might have been better to omit the subject, as it is not peculiar to the electric railway, and there is a whole literature available.

The chapter on the distributing circuit leaves much to be desired. The problem of most economical distribution is in effect dismissed as too complicated for general solution, and the economic arrangement of return feeders is not discussed at all, although the methods in use are generally described. Overhead and third-rail construction are dealt with in a somewhat cursory way. The same criticism applies generally to the treatment of sub-stations, transmission lines, and power generation.

Signalling systems are very well described, with specially full treatment of track-circuiting for various conditions, but more might have been said as to the relation between signal spacing and block lengths, and the train service and speed provided for.

The concluding chapters of the book are concerned with "Systems" and "Engineering Preliminaries." The former is a short description of the continuous, three-phase, and single-phase systems in relation to the traffic requirements. It is noteworthy that the concluding paragraph decides strongly for the single-phase system for heavy service, on the ground that the ability to use any known type of motor with a converting equipment on the locomotive makes it as near a universal system as can be obtained. It is doubtful whether the alternating-current commutator motor will survive, says the author, but this is only an incident to the successful development of the single-phase system. Which pronouncement shows that the author has the courage of his opinions.

The final chapter, "Engineering Preliminaries," is, naturally, only a sketch, but it lays proper emphasis on a careful estimate of traffic possibilities and indicates by example how such estimates can be arrived at with fair accuracy.

It has to be said that the book does, on the whole, fulfil the author's purpose, that it is a valuable addition to the resources of students specialising in electric traction, and by no means without value to engineers and managers designing and operating such systems. The various sections are not of equal merit. Some of the chapters might very well have been omitted, as they deal with subjects somewhat off the main track of the book, which must themselves be specially studied. There are certain signs of haste and ineffective proof-reading, such as the repetition, sometimes in almost the same words and within a few lines, of the same statement. There are also somewhat numerous cases of obscure wording, not all of them due to Americanisms. In few cases, however, will these conceal the author's meaning from a careful reader, and though the Americanisms jar a little on British readers with a preference for the constructions they are accustomed to, they do not detract from the practical value of the book. The diagrams and illustrations are good and clear, containing nothing of the catalogue order, which wastes so much space in many technical books.—H.M.S.

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*A Treatise on Electricity.* By F. B. PIDDUCK. Cambridge University Press. Price 14s. net.

The title of this book gives little idea of its scope; it is not an elementary treatise on electricity, but an advanced text, covering both the theoretical and practical sides of the subject as far as this can conveniently be done in a single volume. And it is not an *ordinary* type of advanced text-book. The first eight chapters contain all the matter usually found in advanced texts, while the remaining chapters form introductory accounts of special subjects which the author suggests may be consulted by students before starting on treatises devoted to them alone. Some of these introductory accounts appear to us to rival in clearness and completeness the more pretentious volumes to which they are intended to lead; they certainly provide all that is necessary for a thorough understanding of even the most advanced sections of theoretical electricity.

It is thus evident that Mr. Pidduck's book is not intended for beginners; rather is it a book whose proper reading and digestion would be substantial fare for the student who aspires to an honours degree in physics.

The first chapter is a mathematical introduction, and deals straightforwardly with all the mathematical conceptions necessary for a proper study of magnetism and electricity: vectors, Green's transformation (attributed by the author to Gauss), Stokes's theorem, the equations of wave motion, and Bessel functions. Chapter II is devoted to magnetism, and Chapter III to electrostatics; both subjects are treated mathematically and experimentally, and suitably illustrated. A very useful account of the theory of dielectrics is given, the prismatic crystal method of mapping electrostatic fields is described, and illustrations are given of two condenser fields.

Into the next 100 pages the author has condensed all that matters in the subjects of electric currents and magnetic effects of currents. Starting from simple cells and galvanometers—and thus leaving very little, even of the most elementary matters, to chance—we have a thorough treatment of units, resistances, Ohm's law, and measuring instruments of all kinds, including moving-coil, string, and ballistic galvanometers, electro-dynamometers, and current balances. Two sections in this part of the book, one on resistance thermometry and the other on the equations of the electro-magnetic field, serve as convenient stepping-stones to two later chapters—on thermo-electricity and electric oscillations.

The treatment of thermo-electricity is a delightfully-written summary of the Seebeck, Peltier, and Kelvin effects, concluding with a section on thermal galvanometers. Without going into many pages, the author has given a much fuller and more satisfactory account of induced magnetism than is to be found even in advanced text-books of much greater bulk, and in the two following chapters on induction of currents and applied electricity the standard set in the earlier sections is well maintained.

As already indicated, the first part of the book is intended as a foundational basis upon which to build a structure of advanced work, and there is no doubt whatever that in the first 300 pages the essential facts in the sciences of electricity and magnetism are set forth with a painstaking thoroughness which leaves nothing to be desired.

The second part of the book consists of five chapters, which introduce the subjects of electrolysis, electric oscillations, conduction of electricity through gases, radioactivity, and the theory of electrons. The treatment in every case is suggestive rather than exhaustive, but it is a suggestiveness which has nothing in common with the superficiality of treatment which sometimes masquerades as "introducing more advanced topics without enlarging upon them."

In the chapter on electrolysis, the ionic theory is developed and applied to voltaic cells, reversible cells and concentration cells, the last type being treated with exceptional clearness in a very few pages. The important experimental methods of Kohlrausch, Lodge, Whetham, and Nernst are described, as

well as an ingenious method of measuring liquid resistance, presumably developed by the author, and used in the Electrical Laboratory at Oxford.

The sections devoted to electric oscillations, conduction through gases, and radio-activity are, perhaps, the most interesting in the book. The measurement of transients by thermal galvanometers, their detection by crystals and oscillation valves, the experiments of Hertz, Tesla, Bjerknes and others on electric waves, the theory of electric oscillations and its application to resonance circuits and wireless, are all important features of the first of these chapters—a chapter remarkable for its sound practicality as well as for the completeness of its theoretical treatment.

The remaining sections are equally exhaustive and up-to-date, and include interesting references to the work of Bragg on X-ray spectroscopy, the Zeeman effect, and the still more recent theories and speculations of Planck and Einstein. The book is well illustrated throughout, and we have seldom read an advanced treatise with more profit and pleasure.—P. H. S. K.

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*Pole and Tower Lines for Electric Power Transmission.* By R. D. COOMBS. London: Hill Publishing Co. Price 10s. 6d. net.

The rapid growth of the use of electric power within the last few years has necessarily led to large extensions in the use of overhead transmission lines—noticeable even in this country, but more particularly so in America. In the future these extensions will become more marked, and for this reason we welcome the advent of a book of this character.

Only the mechanical and structural side of the problem is dealt with, purely electrical details being entirely omitted. This is well, since the mechanical strength and the stability of a transmission line are, of course, of overwhelming importance as regards continuity of supply.

Chapter I deals with types of construction, and is well illustrated with a number of photographic reproductions.

A good deal of practical information regarding the loads to be expected in transmission lines due to sleet and wind is next given. A distinction is rightly made between the effect of wind on cylindrical surfaces and on flat surfaces, but to the reviewer the figures given appear to be on the optimistic side.

Chapter III discusses wires and cables. A considerable number of formulæ and tables are given, dealing with the stress due to temperature changes, &c., and the properties of materials respectively.

We next have a chapter dealing with the special parts of structural engineering which are involved in this subject. A large number of column formulæ are given, together with curves plotted from them, although, as the author himself says, the principal load that a pole or tower must withstand is that which it takes as a cantilever. Useful advice regarding the use of poles on curves and at corners is given.

Wooden poles, faults in timber, methods of preservation, and so forth are treated in a distinctly satisfactory manner in the succeeding chapter, while Chapter VI deals with steel poles and towers in a similar fashion.

Chapter VIII is devoted to the comparatively new subject of concrete poles. The author has evidently had considerable experience with this class of work, and the chapter is a decidedly valuable one. It is illustrated by a large number of photographs, some of which, however, could have been displaced by line drawings with advantage.

The remainder of the book is chiefly devoted to the erection and costs, and to the protection of transmission lines. The treatment is good and practical, but, of course, the costs being those of American practice are not of much use in this country.

On the whole, the book is a decided acquisition to technical literature. The chief fault the reviewer has to find is that the numerous photographic reproductions are on too small a scale, and, further, in some cases dimensioned drawings would have been of more use. The book is got up in a style to be expected from the publishers.—H. G. S.

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## AN INTERNATIONAL HIGH-PRESSURE SUBMARINE CABLE.

THE submarine cable which has been in service since December last, carrying electrical energy from Sweden to Denmark across the Öresund, is remarkable on account of its international nature and, to a still greater extent, by reason of the fact that it is the longest high tension, heavy current, underwater cable yet installed. The cable represents the fulfilment of an agreement by which the South Swedish Power Co. (Malmö) undertook to furnish energy to the North Seeland Electricity and Tramway Co. (Hellerup, Copenhagen) from its power house at Lagan, about 50 miles north-east of Helsingborg. This power station, it may be remarked, also supplies energy to the Swedish towns of Halmstad, Helsingborg, Landskrona, Lund, Malmö and other communities. The possibility of obtaining power from Sweden had been discussed seriously for some years past, but the Danish Government had hitherto opposed the idea on military grounds, which certainly do not seem at all trivial, in view of the important *rôle* soon played by electricity in any community when it is available. However, the agreement between the Swedish and Danish companies was completed early in 1914, and the Felten-Guilleaume firm was given the contract for the submarine cable and the lengths of land cable connecting it to the transformer stations on each side of the crossing. The sea cable was laid in June, 1914, but the outbreak of war delayed completion of the land lines till last autumn. Only about 370 KW. is at present transmitted from Sweden to Denmark, but as the Seeland network extends the load will become much heavier.

The submarine cable itself is about 3·4 miles in length and was made in nine pieces, each about 650 yd. long and 20 tons in gross weight (including the cable drum). Impregnated paper insulation is used between the three cores (each 70 sq. mm. in section), and profile-wire armouring is applied over the lead sheath. The cable operates normally at 35,000 volts, and was tested after manufacture to 87,500 volts. It is to be hoped that the margin of safety is sufficient, for if a fault should develop, due to pressure surge or other cause, and the sheathing of the cable were pierced, the whole section concerned (if not the whole cable) would be ruined by ingress of sea water before the fault could be located and recovered.

Laying the cable and completing the joints satisfactorily was a far more serious problem than manufacturing the material. Greater precautions had to be taken than are necessary in laying and jointing gutta-percha telegraph cables, and there was little or no previous experience from which to work. The difficulty of keeping the cable and the joints dry was magnified a hundredfold as compared with land conditions, and there was always the risk of damaging the cable mechanically, and hence electrically, by stresses due to its own weight or other cause. Special equipment and special precautions were required to provide against jamming of the paying-out gear, too sharp bending of the cable, injury by wave action, and so on. The joints were made according to usual land practice, the lead sleeve being enclosed in a strong guard-sleeve extended on to the armouring at both sides of the joint, so that the latter is moisture-proof and relieved of mechanical strain. The deepest joint lies in 125 ft. of water. After being laid, the whole cable was tested for half-an-hour under 1½ times the working pressure.

The complete power scheme consists of a 50,000-volt transmission line from the Lagan R. power house to a transformer station at Helsingborg, where the pressure is reduced to 25,000 volts. Thence an underground cable (three miles in length) runs to a switch-house at Palsjö, north of Helsingborg, where connection is made to the submarine cable. The latter is brought ashore on the Danish side north of Marienlyst, whence about one mile of underground cable leads to a transformer station at Elsinore. About 200 yd. north of the power cable, there is laid a heavy, armoured four-core gutta-percha cable which serves the double function of telephone cable and guard cable, catching the anchors of vessels drifting in storm or current, and thus protecting the high-tension cable. South of the latter there are three telegraph cables.

No trouble has been reported during the six months this cable has now been in operation, and its future behaviour will be watched with interest, since there are many places in the world where submarine power transmission over a distance of a few miles will be much appreciated if it can be arranged reliably and at reasonable cost.

Similar submarine power transmission schemes, of less importance, between the mainland and islands in the Baltic, were described in our issue of July 11th, 1913, the methods employed for laying the cables being fully illustrated.

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## CORRESPONDENCE.

*Letters received by us after* 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

### Female Sub-station Attendants.

Is it not time that putting women in charge of converter sub-stations is put a stop to? Surely this is the very job for disabled naval and army men, yet Glasgow has some sub-stations entirely in charge of females, and your contemporary which has an article on the subject goes on to state that these women are drawn from the educated business class of woman, which possibly means that they have already good homes and fathers earning good salaries. Your contemporary also mentions the rate of pay, viz.:—21s. to 27s. per week; this possibly explains that what is wanted is cheap female labour, as the pre-war rate was, I believe, 40s. to 45s., which wage would be fairly good for a disabled soldier or sailor with a small pension; if educated business women must be given good berths in electricity works, would it not be much safer to train them for, and make them into, the chief engineers and managers of the same at $\frac{1}{10}$th of what some of the present figure-heads get, and leave mechanics (male) to look after all running machinery. The money thus saved could be used to employ a good firm of (*male*) consulting engineers to look after the extensions and other interests on the technical side of the concern.

**Commercial.**

[Certainly the posts in question are admirably adapted for disabled soldiers and sailors; we have no doubt that the employment of women in sub-stations is only a temporary measure, and that every effort will be made to employ the former as far as possible.—EDS. ELEC. REV.]

### Induction Motors on Circuits of Different Frequencies.

Not being acquainted with the designing of single-phase induction motors, but interested in their installation, I should very much like to hear what other readers of the REVIEW have to say with regard to the use of induction motors on circuits of slightly different periodicity to that which the machine is designed for. For instance, a 50-cycle machine on a 60-cycle circuit, or *vice versâ*.

I frequently find motors in use under the above conditions, although I have always understood that it is bad practice, and presume the "power factor" and efficiency of the machine run under such conditions suffers, and also, to some extent, the output.

I should very much appreciate it if one of your correspondents would enlighten me on this subject, which I happen to know is not quite clear to many others.

**Practice.**

*July 12th*, 1916.

### Decimal Coinage.

With regard to the letter written by Mr. Alfred Bridges in the current issue of the ELECTRICAL REVIEW, if he is unable to obtain samples of the 1 and 2 centimes pieces I have some for disposal out of my collection, which I have much pleasure in offering. He may also be interested to know that the pieces I have were collected by me over 30 years ago in a country village near Armentières, namely, Au Bas Mesnil, where the charge for seats in the church was 2 centimes for front seats and 1 centime for the rear seats, and 30 years ago these coins were used in the town of Lille by children in purchasing sweetmeats.

**G. Delebecque.**

Walsall, *July 15th*, 1916.

## BUSINESS NOTES.

**North-Eastern Manufacturers.**—We have received a copy of a new and revised edition of the "Directory of Manufacturers, Wholesale Importers, and Exporters, of the North-Eastern Railway System." The Commercial Agent of the N.-E. Railway Co., at York, has been induced to publish this third edition of the book by the unqualified successes of the earlier issues; also in view of the new trade conditions which will obtain after the war, causing a much heavier demand for British products. In the course of some 1,300 pages there are over 36,000 entries appearing under more than 1,200 trade headings, the entries being classified as to town and as to industry. There is a coloured map of the railway system showing the principal natural products of different districts, and particulars of normal Continental and Overseas sailings are given. As many as 15,000 copies of the "Directory" have been prepared for purely gratuitous distribution, and Consuls and Chambers of Commerce everywhere will be among the recipients.

**Electrical Goods Wanted in Spain.**—The Consul Général of France at Barcelona forwards to the Office National du Commerce Extérieur a list of the articles which were supplied by Germany before the war to the big stores which go by the name of "El Siglio," and which are probably the largest distributors in Spain. Among the articles enumerated are:—Instruments of precision for the arts and trades, steam and electric motors, pocket electric lamps, dry cells for electric lamps, electric and steam toy motor and railway accessories.

**Australian Trade Inquiry.**—Reuter reports that the Australian Commonwealth has decided to appoint a Commission, consisting of six manufacturers and six workers, to visit the United States and investigate and report upon American methods of manufacture and production, and upon conditions of employment. A scheme is proposed for the establishment of Government cable works for the manufacture of wire cables and metal ropes, rendering Australia independent of outside sources for these commodities.

**Patent Applications.**—Application has been made by F. J. Laverack & B. D. Potter, liquidators of the Eloesser Steel Driving Belt, Ltd., for the restoration of the following patents granted to Carl Eloesser:—

Nos. 18,169 and 18,170, of 1908, for "Improvements relating to endless metal driving bands."

No. 22,472, of 1907, for "Improvements in power transmission gearing."

**German Enterprise in Morocco.**—M. Lucciardi, the French Vice-Consul at Tetuan, states that German travellers have arrived in that town, and are offering German goods at extremely low prices. French travellers, the Vice-Consul says, would, therefore, do well to pay a visit there forthwith, or at least send in their price, particulars and catalogues. He is prepared himself to distribute these, but urges the need, in any case, for immediate action.

**Italy.**—An amalgamation has been arranged between the Società Elettrica Prealpina and the Società Bergamasca, the new company formed being styled the Società Elettrica Bergamasca, with a combined share capital increased from 4,400,000 lire to 6,360,000 lire.

**Book Notices.**—*The Coming Crash of Peace and Briton's Mechanical Renaissance.* By T. C. Elder. London: Simpkin, Marshall, Hamilton, Kent & Co., Ltd. 2s. net.—The writer's object is to state forcefully the need for organising our increased engineering capacity in readiness for after the war, and taking proper steps at once to that end, without depending too much upon the Government. The consolidation of industrial forces through the United British Industries Association, in which a £1,000 individual subscription will ensure a continuous interest in the organisation, is favourably commented upon, and a proposed chart of departmental interests of a Ministry of Commerce is drawn up. For the rest, the book consists in the main of a reprint of the series of addresses delivered by the author before meetings organised in the provinces by the B.E.A.M.A. on "Engineering Industry and Public Policy," "What After Munitions?" "The Business Side of Science," "Engineering Industry in the Economic War," and "Engineering for the Empire."

*Trade as a Science.* By E. J. P. Benn. London: Jarrold & Sons. 2s. 6d. net.—We have read this book with an interest which has been sustained practically from cover to cover. We are not required to state that we are in agreement with everything that the author says, but in his efforts to raise the status of industry and trade, and to secure for them a larger measure of recognition in high circles, he certainly has our best wishes. As Mr. Benn remarks, the organisation of trade (in which, like many other people, he includes industry), is a subject worthy of the closest attention of every business man. He desires to see it organised, in order that it may have a corporate existence and a voice of real authority. He rightly dwells somewhat fully upon the possibilities of associated action, and in one of his chapters puts forward a tentative scheme for the organisation of a Ministry of Commerce, and a system of official trade associations. He wants to see trade and party politics divorced; would arrange and control the trading associations in Government co-operation, so as to prevent the evils attendant on trust systems; advocates co-operation between manufacturers in respect of production, avoiding the needless locking up of capital in unnecessary stocks; and shows that if the export trade is developed to its fullest extent, no man need fear the lack of a job or be content with low wages. We may not entirely concur in his opinions regarding the average British business man, and on some other matters, but the volume forms a timely contribution to the literature of a subject which is in most men's minds to-day, and will well repay reading. Indeed, we have no hesitation in strongly recommending it.

*Fire Protection for Passenger Ships* is the title of Red Book No. 203, which the British Fire Prevention Committee has issued for the use of ship owners, ship builders and their technical advisers when considering schemes for laying down new mercantile tonnage for post-war purposes. The subject is exhaustively discussed, and the installation of automatic fire-alarms, and ordinary fire-alarm systems, is recommended, amongst many other precautions. The publication is obtainable at the Committee's offices, price 3s. 6d.

"Mechanical Engineers' Handbook." Edited by L. S. Marks. Price 21s. net. "The Electrical Contractor." By L. W. Moxey, Junior. Price 6s. 3d. net. London: Hill Publishing Co., Ltd.

"U.S. Bureau of Standards." Scientific Paper, No. 277, "Photometric Comparison of Glass Screens and of Tungsten Lamps"; Scientific Paper, No. 280, "Volatilisation of Platinum"; Technological Paper, No. 58, "Strength and other Properties of Concretes."

**Bankruptcy Proceedings.**—R. E. CONNOLD, late electrician, Canterbury. The following are creditors:—

| | | | |
|---|---|---|---|
| British Thomson-Houston Co... | £40 | Henley's Telegraph Works Co. | £10 |
| Court Bros. .. .. .. .. | 12 | "Bankers" .. .. .. .. | 98 |
| Bickle, Miss... .. .. .. | 167 | Stirling, C. .. .. .. .. | 21 |
| Edison & Swan Elec. Light Co. | 30 | British Ever-Ready Co. .. .. | 17 |
| Eldridge & Morris.. .. .. | 40 | Reeves Bros. .. .. .. | 17 |
| Gabb, Mrs. .. .. .. .. | 100 | Millard Bros. .. .. .. | 15 |

F. BROWN (partner in Hugh Bros. & Brown, Llanelly), electrician.—Receiving order made July 11th, at Carmarthen, on debtor's petition.

**Liquidations.**—PLUTTE, SCHEELE & CO., LTD.—Creditors must send particulars of debts, &c., to the controller, Mr. G. W. Roberts, 133, Wool Exchange, E.C., by September 30th.

OTTO BOHNDEL, trading as Schoen Bros., an enemy subject.—Final notice is given asking creditors to communicate with the controller, Mr. J. W. Barrett, 19A, Coleman Street, E.C., by August 15th.

ELECTRO-FLEX STEEL CO., LTD.—This company is winding-up voluntarily, with Mr. B. A. Fitzgerald, Collingwood Buildings, Newcastle-on-Tyne, as liquidator. A meeting of creditors is called for to-day (July 21st).

ASTER ENGINEERING CO. (1913), LTD.—A meeting is to held at Wembley on August 25th to hear an account of the winding-up from the liquidator, Mr. S. D. Begbie.

**Catalogues and Lists.**—MESSRS. H. TINSLEY & CO., Eldon Park Works, South Norwood, London, S.E.—Twenty-four page catalogue, containing full particulars with illustrations and prices of Dr. Drysdale's combined inductance and capacity testing bridge, also instructions and diagrams relating to same.

MESSRS. DOWNES & DAVIES, 1 and 3, Stanley Street, Liverpool.—Handy reference table of carrying capacities for cables and fuses, which they are issuing to their customers.

**Trade Announcements.** — Messrs. Kohler Bros. notify that from July 31st, their address will be Salisbury House, London Wall, E.C. Telephone number: "Central 488."

Messrs. Lund Bros. & Co., announce that owing to the increase in maintenance and repair business, new premises have been taken at 15, Cromer Street, Gray's Inn Road, W.C. (Telephone number: "2876 Holborn.") The City office is being continued at 49, Queen Victoria Street, E.C.

**Australian Metal Manufacturing.**—The cabled report of the Mount Morgan Gold Mining Co. contains the following:—"This company in association with Hampden, Electrolytic, British Insulated & Helsby Cables, inaugurated Metal Manufactures, Ltd., objects of new company, manufacture copper wire, sheets, tubes. Company has received assurances support Commonwealth authorities justify establishment industry. There is increasing demand for goods contemplate manufacturing hitherto imported. Capital of company £200,000, of which £60,000 issued, this company's participation being 20,000 shares."

**Argentina.**—La Constructora Electromecánica is the title of a new electrical and mechanical works started in Buenos Ayres, and Messrs. D'Agostino and Agners have opened an electrical manufacturing works in the city of Entre Rios. The specialities of the former firm are the conversion of naphtha motors into Diesel engines, and the construction of accumulators.

**The Italian Trade Outlet.**—The French Chamber of Commerce at Milan has begun a canvass of Italian buying firms, with a view to ascertaining the kinds of goods which are likely to find a sale in Italy. Among the electrical requirements there is an opening, it is stated, for three-phase 45-kw. electric motors, 2,000 volts, 50 periodicity, and 500 to 550 revolutions per minute. A list of the names and addresses of buyers has been compiled.

## LIGHTING AND POWER NOTES.

**Aberystwyth.**—Price Increase.—The Electricity Co. has informed the T.C. that the price of current has been further advanced by 10 per cent.

**Accrington.**—Through the reduced consumption of electricity for domestic purposes, following upon the adoption of the Daylight Saving Act, the electricity department has adopted a suggestion by the borough treasurer that very small accounts for the June quarter should be held over until the close of the next quarter.

**Argentina.**—The Government has made a grant of 350,000 pesos, towards the total of 361,000 pesos, required for the illumination of the Capital on the occasion of the national festival, held for six days in July. Over 160,000 electric lamps were to be employed, and 240,000 kw.-hours of energy were to be consumed, at a cost of 25,000 pesos, for additional energy consumed in the ordinary service.

**Barnes.** — Joint Working Arrangements. — The Council has decided to allow the electrical engineer to represent it on the Joint Advisory (Engineers') Board, which the chief engineers of the municipal undertakings supplying electricity in the Western Metropolitan Police area decided, at a recent conference, should be formed as the first step towards concerted action regarding the future development of the undertakings in the area mentioned. An application from a neighbouring authority inquiring upon what terms the Council would be prepared to furnish it with a supply of current in bulk has been referred to the engineer for report.

**Bradford.** — At a meeting of the City Council, recently, the chairman of the Gas Committee made a statement in answer to a number of questions of which notice had been given by a member of the Corporation. It was admitted that since July, 1913, whilst 138 firms had introduced gas engines, 50 of these had ultimately changed over to electric motors. A few new gas-engine customers had given up electric motors in favour of gas. The gas department had made no effort to prevent a gas engine being replaced by electric drive when the latter had been obviously more suitable to the particular purpose; indeed, he added, the Gas Committee itself had recently installed 13 electric motors at its own new plant at Birkshall gasworks.

**Burton-on-Trent.**—At a recent meeting of the T.C., Councillor King was thanked for his report on the recent Municipal Electrical Convention, particularly as regards the portion referring to the uses of electricity for agricultural purposes, which Alderman Lowe considered would result in great advantages to the agricultural community in the not distant future.

**Canada.**—It is stated that the Ontario Hydro-Electric Commission being unable to secure sufficient electricity under its contract from Niagara sources, the Ontario Government has asked the Dominion Government to prohibit the export of power to the United States, where it is at present used by many American industries.

**Carlisle.**—Year's Working.—The annual report on the city electric supply undertaking shows a total revenue of £25,109 and gross profit amounting to £9,725 (as compared with £8,341 in 1914-15), while after meeting financial charges the net surplus amounted to £174 (as against £76 in 1914-15). During the year 3,973,039 units were sold, an increase of 502,547 units on 1914-15; power and lighting units alone totalled over 3,000,000, and the increased output was mainly confined to this section. Mr. Purse, the electrical engineer, points out that 154 power consumers averaged a revenue per H.P. of £9·15, giving a total of, roughly, £16,000 revenue, while 711 lighting consumers, with an average revenue per H.P. of £6·65, produced only about £8,000 total revenue, despite the fact that the power consumers paid only a little over 1d. per unit, while the lighting consumers paid about 3¾d. per unit. An increased coal cost during the year of £1,332 was entirely due to increased prices, as actually 100 tons less was consumed than in the previous year. The various increased costs and special charges amounted to £3,600 for the year.

**Caterham.**—Revised Prices.—The Committee appointed by the Urban Council to deal with the proposed increased charges for the supply of electricity by the Urban Electric Supply Co. reported that the rate now proposed is a flat rate of 7d. per unit as a maximum charge. The company is prepared to agree if the Council withdraws its opposition to the proposed alteration, the rate of charge for electricity during the war, and for six months after, shall not be raised by more than 15 per cent. That thereafter the charge shall not exceed 6d. per unit unless with the written consent of the Council, provided that if the company considers the Council is unreasonable in refusing consent under the then existing conditions, the matter be referred to an arbitrator appointed by the B. of T. The Committee recommended the Council to adopt the proposals, which it has decided to do.

**Eastbourne.**—Year's Working.—The report of Mr. Brydges, the borough electrical engineer, on the last year's operation of the electricity department, shows that the output sold declined from 1,816,667 units in 1914-15 to 1,773,737 units in 1915-16. Power, heating and cooking units, however, showed a satisfactory increase. The gross income decreased by £2,907; expenditure increased, and the final result, after meeting capital charges, was a deficit of £911, as against a net profit of £2,208 in 1914-15. A 1,250-kw. Ljungström turbine set was put into service in June, 1915, and has apparently improved the efficiency of the plant generally; a 750-kw. turbine set has been run, partially stripped, owing to the difficulty of getting it repaired, with a decreased steam efficiency of about 10 per cent.

We note that the 4½-ton steam motor wagon used by the department for carrying coal from the railway to the works, has carried 5,841 tons and run 2,921 miles, at an all-in cost per ton delivered of 11·83d.; it is interesting to compare this with the cost of operating the 4-ton electric coal wagon used by the Ilford electricity department for an exactly similar purpose, viz., 9·5d. per ton carried. This later wagon in 65 days ran 793 miles, and carried 2,812 tons, showing, if the conditions are comparable, a considerable saving over steam-wagon haulage, besides advertising the electric vehicle.

**Eton.**—Public Lighting.—The U.D.C. has accepted an offer from the Windsor Electrical Installation Co. reducing the charge of £231 for public lighting by £64 until normal lighting conditions are resumed.

**Halifax.**—The inauguration of new turbo-electric plant installed at the works of the Ripponden Commercial Co. took place last week. The new plant supersedes a beam-engine drive, and was supplied by the Brush Co., at a total cost of £11,000.

**Harrogate.**—It is stated that the output of the electricity works for June showed a considerable increase over the same month last year, despite the lighting restrictions, and that the development of electric heating and cooking may account for this.

**Heywood.**—Bulk Supply.—At a meeting of the T.C. on July 12th, Councillor J. Ashworth, speaking on the electricity report, said that last year they purchased from Bury nearly half the total units supplied, and now they were taking the whole of their supply from them. Owing to the war Bury had not been able to obtain delivery of new boiler and other plant, and consequently had not been able to meet all the demands, and the Heywood Corporation was unable to fully supply its new customers. The bulk supply scheme was fulfilling all that was said in its favour, and its adoption had lifted the electricity department out of a rut, which at one time seemed to be impossible save at an enormous capital expenditure.

**Holmfirth.**—Plant Inauguration.—The Council's new electricity works were opened on Saturday afternoon last; the installation was carried out by Messrs. Broadbent, under the supervision of Mr. A. B. Mountain. The gas lamps for public lighting have been disconnected, and are being removed, as public electric lighting is being adopted.

**Hull.**—Year's Working.—The report of Mr. J. F. Magoris, acting city electrical engineer, on the year's working of the electricity undertaking to March last, shows that 14,795,426 units were sold, against 12,969,776 in the preceding year, and the revenue (£89,208) increased by £6,908. Due to restrictions, lighting revenue fell off very considerably—average per kw. connected, 1913-14, £5·13; average per kw. connected, 1915-16, £3·79—but this was more than compensated for by the increased revenue from power—viz., £9,517, as compared with 1914-15. Total working expenses, inclusive of special charges, amounted to £47,178, leaving a gross balance of £42,030, and after meeting

interest and sinking fund, and special charges, war allowances, &c., the net surplus remaining was £4,247, which was carried to reserve. Despite the increased coal costs, the average works cost ('64d. per unit) and total costs ('79d. per unit) are the lowest yet recorded in the case of this undertaking. The maximum load was 7,810 KW., with 4,888 consumers, and a connected load of 28,790 KW., of which 20,470 KW. represented power, and took 12,834,145 units of the total, producing nearly £53,000 revenue. The Committee, which, we regret to say, has lost the services of its chairman for the past ten years, Ald. Hanger, has contributed nearly £50,000 in the past from reserve towards the cost of capital work, and now has a reserve in hand amounting to £20,500, or over 7 per cent. on the outstanding loan debt, £285,858. We may add that Councillor Pybus has been elected chairman of the Electricity Committee.

**King's Lynn.**—YEAR'S WORKING.—At a meeting of the T.C. last week, the Electricity Committee presented a statement showing that during the twelve months ended March 31st last, the income of the undertaking was £8,068, as against £7,992 in 1914-15. The expenditure was £7,049, and the profit £1,018, against £1,350. The Committee resolved that the surplus be applied in reduction of capital. It was also recommended that the charge for current supplied for lighting be increased ½d. per unit, and that an extra ½d. per unit be charged for power, in place of the last increase of 10 per cent. The report was adopted without discussion.

**London.**—HAMPSTEAD.—YEAR'S WORKING.—The annual report of the chief engineer, Mr. Wyld, shows that, as anticipated, the working of the electricity undertaking during 1915-16 resulted in a loss—viz., £6,700—as against a net profit of £2,767 in the preceding year. The net income was £67,518, showing a decrease of £2,206 on 1914-15, despite an increase in price during the year. The total expenditure, including interest and sinking fund, amounted to £74,228, an increase of £7,271 on 1914-15; fuel alone cost more than £5,000 extra, averaging '79d. per unit, as against '48d. The total output sold amounted to 5,069,397 units, as against 5,550,000 units in 1914-15; the maximum load was 3,128 KW. Modern mechanical-remote controlled H.T. switchgear is being installed by the B.T.H. Co., to replace the old Ferranti board at the generating station. A total of 275 motors, of 1,468 H.P., are connected to the supply, as also 428 hired heaters, cookers, and similar apparatus.

ISLINGTON.—YEAR'S WORKING.—The annual accounts of the Council's electricity undertaking show a net profit for 1915-16 of £2,117, as compared with £2,807 in the previous year. The total revenue amounted to £69,660, and the gross profit to £30,609, or slightly more than in 1914-15. The output sold reached 8,552,729 units, as compared with 7,831,593 units in 1914-15, and included 4,640,000 units for day lighting and power, an increase of a million units on the previous year. The maximum load was 4,989 KW., and the load factor 19·57.

**Oldham.**—YEAR'S WORKING.—The joint engineers and managers of the Corporation electricity undertaking, in their report, show that the total income for the year amounted to £63,920; the gross profit was £26,698, and the net profit, after meeting financial charges and expenditure on meters, amounted to £5,107, as compared with £3,550 in the previous year. This result is traceable to the supply for power purposes of 5,385,229 units, as against 2,779,150 units in the previous year, giving an increased revenue on this account of £9,280, other branches of supply having declined in amount. The total output sold amounted to 10,487,235 units, as against 7,985,859 in the previous year. During the year consumers' sub-stations have been erected at five factories; a 3,000-KW. turbo-alternator, three boilers and accessory plant were commissioned, and a further two boilers are being obtained. One 3,000-KW. turbine set on order was released on the appeal of the authorities for its employment elsewhere. The plant capacity of the Greenhill works was 10,140 KW., the maximum load was 5,260 KW., and the load factor 22·7 per cent. The works, &c., and management costs advanced slightly from '812d. to '852d. per unit.

**Radcliffe.**—PRICE INCREASE.—Advances of 5 per cent. in the price of electricity for lighting, and 10 per cent. for power and heating, are about to be made.

**Southend-on-Sea.**—The "Economy" Committee has asked the Finance and Light Railways Committee to arrange for the more economical control of the accounts of the light railway and electric supply department.

**South Africa.**—A meeting of electricians and fitters in municipal employment has been held at Johannesburg, at which a resolution was passed demanding an increase of 15s. per week in wages.

The Cape Town Corporation electricity department is experiencing great difficulty in coping with the demand for energy, and it is proposed to install additional plant. There has recently been a greatly increased load owing to the use of radiators and cooking apparatus, the rate for which has been reduced to 1½d. per unit, as against 7d. per unit for lighting. The increase has been so great that the department is requiring all consumers to forward particulars of all lamps and other current-consuming apparatus connected to the supply mains. In many districts applications for the installation of radiators have been refused until the new plant is running, which will, of course, be too late for the present winter's radiator demand.

**Tasmania.**—A Launceston syndicate has offered to construct a railway along the Tamar to the cement and steel works, and to provide an electric transmission line from the Great Lake supply, at a cost of £500,000.

**Taunton.**—PRICE INCREASE, &C.—The statement of accounts for the year ended March 31st last, shows a gross profit of £5,955 on the Council's electrical undertaking.

Owing to the reduced demand for electricity for lighting due to the lighting restrictions and the Summer Time Act, it was decided to increase the charges from Midsummer by a further 10 per cent., thus making altogether an advance of 25 per cent. on the scale charges for lighting and power.

**Teddington.**—PRICE INCREASE.—The District Council has been notified by the Twickenham and Teddington Electric Supply Co. that the charges for electricity for all purposes will be further advanced by 10 per cent., making 20 per cent. in all, to take effect from the June quarter.

**Uckfield.**—The D.C. has been notified that the B. of T. has extended the time for the completion of the electricity works of the Crowborough District Gas Co. for 12 months from July 4th, 1916.

**Welsh Water Powers.**—In the House of Commons, in reply to a question as to whether steps had been taken with a view to utilising Welsh water-power to produce electrical energy for agriculture and other industries, Mr. Harcourt said he was not aware of any inquiry into the matter.

**Whitehaven.**—The Harbour Commissioners have asked the T.C. to quote terms for installing the electric light at the West Pier lighthouse.

**Winchester.**—YEAR'S WORKING.—The past year's working of the electricity department showed a gross profit of £5,826, and after meeting interest repayment and other charges, there was a net surplus of £575, as against £1,317 in the previous year.

## TRAMWAY and RAILWAY NOTES.

**Bolton.**—ELECTRIC VEHICLE.—The Electricity Committee has deferred consideration of a proposal to purchase an electrically-propelled vehicle for the use of the department.

**Colchester.**—The T.C. has decided to increase the price of current for the tramways by ½d. per unit.

**Continental.**—ITALY.—Plans are being prepared in connection with a proposed electric tramway to connect the town of Osimo with the Osimo-Ancona railway station.

**Heywood.**—TRACK MAINTENANCE.—The Electricity and Tramways Committee has requested the Surveyor's Committee to undertake the ordinary maintenance of the tramway track for a further period of 12 months, ending March 31st, 1917, for the sum of £750.

YEAR'S WORKING.—The annual report of the tramway undertaking shows a total income of £11,985, compared with £11,626 in 1915; a total expenditure of £8,188, compared with £7,944; and a gross profit of £3,796, compared with £3,681. The car-miles numbered 263,553, and passengers carried, 2,366,551. The sum for interest and sinking fund charges, including £1,165 for the award to the Bury, Oldham, and Rochdale Tramway Co. was £4,314, and there was a net loss of £518.

**Hindley.**—The Wigan Corporation has informed the U.D.C. that, owing to Government restrictions, it had been compelled to postpone further consideration of the Market Street tramways matter for a short time.

**Huddersfield.**—DEFERRED EXTENSIONS.—The tramway extension to Brighouse to link up with the Bradford system has again been postponed, this time to the end of the war.

**London.**—YEAR'S WORKING OF L.C.C. TRAMWAYS.—The annual accounts of the Council's tramways for the year ended March 31st last shows total receipts amounting to £2,339,291 and working expenses (including war service allowances) of £1,683,660, leaving a gross surplus of £655,631. Interest, sinking fund, and other charges amounted to £729,426, showing a deficit of £73,795 on the year's working. This figure compares with the original estimated deficiency of £91,614 and a subsequently revised estimate of £64,190. No payment has been made to the renewals fund during the year, but £73,255 has been spent out of it, leaving a balance in the fund of £329,968. The deficiency for the year has been met out of the general reserve fund, leaving a balance in hand of £70,118. In order to meet the expenditure on renewals and the transfer from general reserve, it was necessary to realise certain securities at a loss of £11,532 and £23,621 respectively on cost price.

During the year, 545,423,397 passengers were carried and 47,879,675 car-miles run, these figures comparing with 550,497,993 passengers and 58,978,792 car-miles in 1914-15. The capital ex-

penditure at March 31st amounted to £13,516,577, and the debt outstanding, less value of surplus land, was £9,580,991. Capital expenditure on obsolete horse lines still to be provided for amounts to £971,878. The report mentions the progress made in reconstructing the Greenwich tramway power station, by which its capacity will be increased from 34,000 KW. to 52,000 KW. The tramway system is linked up with another source of supply to provide against breakdown, and inquiries are now being made with a view to interconnection for reciprocal supplies of power; 150 trailer-cars have been ordered, and 120 of them are in use. The route length of electrified tramway amounts to 141½ miles; two horse tramway routes, on which electrical reconstruction has been stopped by the war, are not now being worked. Through services are in operation with the Metropolitan Electric Tramways and the Leyton and Bexley Councils' systems; various through booking arrangements are in operation also. There are 1,150 women conductors employed on the cars.

*L.C.C. Tramway Estimates.*—For the year 1916-17 it is estimated that there will be a gross surplus of £674,465, while debt charges and taxes will amount to £748,557, leaving a deficiency of £74,092, which will be met in the first instance from the general reserve fund. The estimates contain provision for £20,000 contingencies and £122,500 for war service allowances, but it is considered probable that this latter sum will be insufficient. But for these special charges the working would show an estimated surplus of £68,408. No addition is contemplated to the renewals fund, while it is estimated that £96,300 will be expended from it. The balance of the general reserve fund, after meeting the estimated deficit, is estimated at £6,798; it it considered probable that this will be more than absorbed, particularly as the value of investments has been taken at cost price.

**Sheffield.**—YEAR'S WORKING.—The annual report on the working of the Corporation tramways and 'buses during 1915-16, shows a total tramway revenue of £456,609 (car receipts being £58,000 in excess of the previous year), and gross profits amounting to £173,460, after allowing for £11,209 war allowances. Deducting interest and sinking fund charges, income-tax, &c., the surplus balance remaining was £95,780, an increase of £25,841 on 1914-15. From the surplus £41,856 was allocated to rate relief, over £30,000 to renewals, and the balance for various purposes, including a special grant (£5,000) to the Sheffield University. During the year 123,429,410 passengers were carried, as against 107,023,195 in the previous year, the average traffic revenue amounting to 12·17d. per car-mile, as against 10·66d. The car-miles at 8,867,726 represent a decrease of 57,000 miles, as compared with 1914-15. The route mileage of the tramways amounted to about 40¼. The electricity department has taken over the Kelham Island Tramway power station and cables, and, pending its regular transfer, is responsible for debt charges, &c., on the capital expended. The tramways now employ 706 women conductors, depôt workers, &c. The department also operates motor-'buses on 10 routes, having a total length of 30 miles, some of which extend beyond the city boundary. These vehicles ran 540,628 miles, earning 1s. per mile, or a total income of £27,565; the net balance, after providing for debt charges, depreciation, taxes, &c., was £3,816.

**Talycafn.**—The Aluminium Corporation, whose works are situated between Talycafn and Trefriw (North Wales) is making application to Parliament for powers to construct a railway from the works to join the London and North-Western Railway at a point in the parish of Maenan, where it is proposed to provide a goods and passenger station.

## TELEGRAPH and TELEPHONE NOTES.

**Automatic Telephones.**—The automatic telephone exchange which has been installed at Paisley was to be put in operation on Monday last. The installation at present takes 1,200 lines, but its ultimate capacity is 2,500. The plant has been manufactured and installed by the Automatic Telephone Co., of Liverpool.

**Rhodesia.**—At the end of 1914 there were 5,300 km. of telegraph line under the control of the Administration, and 12,554 km. of wire, the total number of offices being 108; over a million messages were handled during the year. The receipts for the year were 971,382.15 fr.—*Journal Télégraphique.*

**South Africa.**—At the end of 1914 the telegraph system of the Union included 24,182 km. of line and 81,066 km. of wire, as well as 10,054 km. of wire used also for telephonic communication. The number of telegraph offices was 1,602. Telegrams handled during the year amounted to 6,383,564, and the revenue was 8,918,500 fr. The telephone system comprised 6,872 km. of line and 137,644 km. of wire in use, with 29,400 telephones connected; 57,400,000 messages were dealt with. The receipts amounted to 6,968,250 fr. The expenses of the telegraph and telephone systems are not separated from those of the postal service.—*Journal Télégraphique.*

**Telegrams by Telephone.**—The Post Office is calling attention to the facilities offered for the delivery of telegrams by telephone. It is pointed out that there is a scarcity of boys for messenger duties, and the prompt delivery of telegrams is difficult.

**Telegraph Rates.**—Telegrams may now be sent to Newfoundland by cable for 1s. a word, and by Marconi at 8d.; also to the Caroline Islands for 3s. 11d.

## CONTRACTS OPEN and CLOSED.

### OPEN.

**Australia.**—August 16th. P.M.G. Distilling apparatus (Schedule 502), telegraph and measuring instruments (Schedule 498). See "Official Notices" June 16th.

SYDNEY.—August 17th. Portable internal-combustion engine and dynamo (2½ KW.) for the Departmental Stores, Sydney, for P.M.G.*

August 24th. P.M.G. Automatic switchboard and apparatus for North Sydney Exchange. Schedule No. 511.*

**Basingstoke.**—July 28th. Wiring the Conservative Club for electric light. Mr. A. E. Grant, Secretary.

**London.**—L.C.C.—The Highways Committee recommends that tenders be invited for steam, exhaust, &c., piping, in connection with the third additional turbo-generator at the Greenwich generating station, and that the chairman and vice-chairman of the Committee be severally authorised during the summer recess to open any tenders received for the work.

July 26th. H.M. Office of Works. Batten holders, ceiling roses, switches, plugs, and cut-outs. See "Official Notices" to-day.

**New Zealand.**—INVERCARGILL.—September 28th. Borough Council. Steam turbo-alternator, condensing plant, and switchgear. Specifications from the Tramway Office. Contract No. 40.*

**Walthamstow.**—July 26th. Council. 500-KW. rotary or motor converter; E.H.T. switchgear; L.T. switchgear. See "Official Notices" July 14th.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

### CLOSED.

**Ashton-under-Lyne.**—Electricity Committee:—

T. King.—75 tons of coal per week for three months.
Kelsall Bros.—60 tons of coal per week for six months.
J. Rawlings.—30 tons of coal per week for six months.

**Barnsley.**—Electricity and Lighting Committee:—

Thomas Lindley.—Reinforced-concrete flooring and concrete foundations for engines at electricity works, £548.

**London.**—L.C.C.—The Highways Committee purchased 43,835 tons of coal for use at the Greenwich generating station, at a cost of about £70,000, during the quarter ended June 30th last. The Committee has accepted the tender of Messrs. Pinchin, Johnson & Co. for insulating varnishes. The Stores and Contracts Committee accepted the tender of the British Westinghouse Electric & Mfg. Co. for the supply of electric traction glow-lamps for the Tramways Department, for the three months ended June 30th.

**Southend-on-Sea.**—Lighting Committee. Recommended tenders:—

Venner's Time Switches, Ltd.—200 current limiters.
Callender's Cable & Construction Co., Ltd.—Various cables (six months).
B.I. & Helsby Cables, Ltd.—100 pairs cut-outs for sectional boxes.

**Stoppage of Building and Engineering Works.**—The following important notification has been issued by the Ministry of Munitions:—

"In pursuance of the powers conferred on him by Regulation 8E of the Defence of the Realm (Consolidation) Regulations, 1914, the Minister of Munitions hereby orders as follows:

"On and after the twentieth day of July, 1916, no person shall without licence from the Minister of Munitions commence or carry on any building or construction work, that is to say, the construction, alteration, repair, decoration, or demolition of buildings, or the construction, reconstruction, or alteration of railroads, docks, harbours, canals, embankments, bridges, tunnels, piers, or others works of construction or engineering. Provided that where the total cost of the whole completed work in contemplation does not exceed the sum of £500 and the use of constructional steel is not involved, the licence of the Minister of Munitions shall not be required."

The notice does not relate to Government contracts, or to already-authorised municipal contracts.

All persons desirous of obtaining a licence should apply in writing to the General Secretary, Ministry of Munitions, 6, Whitehall Gardens, S.W., giving full particulars of the description and locality of the work, the purpose for which it is intended, and its estimated cost, and such further information as the Minister may require.

## NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

### B.T.H. Ironclad Switch Fuses.

We illustrate in fig. 1 one of a range of totally enclosed ironclad switch fuses, which have been put on the market by the British Thomson-Houston Co., Ltd., Rugby, for circuits up to 700 volts, in 20-ampere and 60-ampere sizes. The fuse clips and terminals

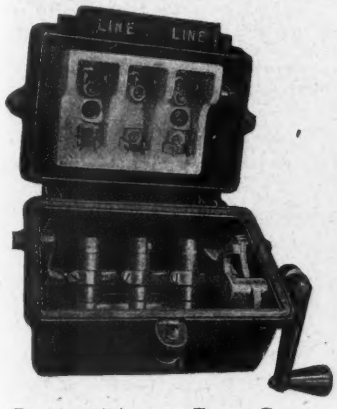



Fig. 1.—20-Ampere Triple-Pole Switch Fuse. Open.

Fig. 2.—60-Ampere Switch Fuse, Closed.

are mounted on porcelain bases, with insulating barriers to prevent arcing across or to the case; the movable parts are carried by the hinged cover, and all parts are accessible when the case is open. Quick make and break and interlocking arrangements are provided; the hinges are machined, and a tight joint is made between case and cover. Adapters for screwed conduit and shields for back-of-panel connection can be provided.

### "Arora" Cooking Apparatus.

The Arora Co., of Loughborough, is placing on the market a new electric grill, designed to meet the pressing need for rapid grilling and toasting; as shown in fig. 3, it is made of cast-iron, with an aluminium finish. The heating elements are formed of an extra heavy section of wire, and are mounted on the underside of strong fireclay bars; thus the heat is thrown downwards, and, owing to the high radiation of the elements and the fireclay, the grill is ready for use directly the current is switched on. The power consumption is about 1,100 watts, and the operation of grilling takes from five to ten minutes, according to the thickness of the steak or chop. The electrical part of the grill can be lifted off, so that the rest of the device can be thoroughly washed without risk of damaging the elements; the detachable part can also be used separately as a "salamander."

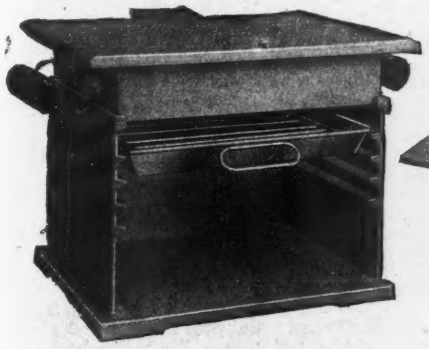


Fig. 3.—"Arora" Grill.

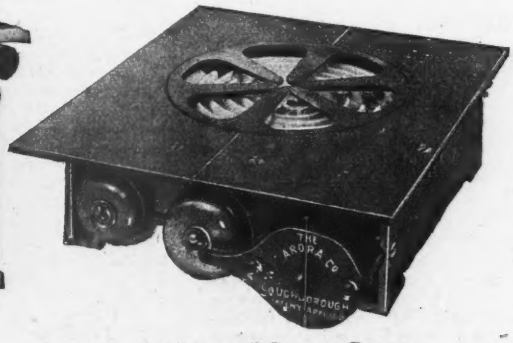



Fig. 4.—"Arora" Boiling Plate.

Another new device is a three-section electric boiling plate, for rapid boiling, shown in fig. 4. This has a cast-iron frame, so designed that it will not crack with the heat, which supports a heavy fireclay disk retainer; three sector-shaped heating elements are supported on the disk, each being held in place by two wing nuts, so that any sector can be replaced without interfering with the others. The full-load consumption is 1,500 watts; by means of two switches, one-third and two-thirds of the full heat can also be obtained, and the interlocking slide seen at the front adds a further control, giving one-ninth of the full heat, which is useful for simmering purposes. Heavy flexible cable armoured for 18 in. is provided, as well as an earthing wire. The cooking surface measures 14 in. × 12 in., and the grid has an opening 8 in. in diameter.

An electric fire, with three bars, has been added to the list of sizes available, as well as a neat cast-iron hearth stand.

### "Twinob" Switch Motor Controls.

The Lundberg "Twinob" tumbler switch has been slightly modified, as shown in fig. 5, to ensure that one arm shall be put on before the other, and that both shall be put off together. The illustration shows one arm on and the other off; this being the starting position of the switch. The arm which is "on" has an open box at its extremity, which encloses the knob of the other lever when both are on or off. The switch, of course, is provided with a cover.

The switch can be used for the control of small D.C. shunt or series motors. In the simplest connection for a shunt motor, and without a resistance, the box lever completes the field circuit, and the ordinary lever the armature circuit. Fig. 6 shows the connections for a shunt motor with a starting resistance R. The lever which goes on first is marked K, this putting the supply straight on to the field, and through R to the armature. The second lever bridges R. The same arrangement of resistance may be used for a series motor. The switch is made in 10- and 5-ampere sizes, and can be fitted with ordinary or Admiralty pattern terminals. The makers are Messrs. A. P. Lundberg & Sons, of 477-489, Liverpool Road, London, N.

Fig. 5.—"Twinob" Motor Control Switch.

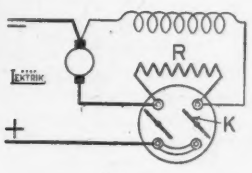



Fig. 6. Diagram of Connections of Motor Control.

## NOTES.

**Commerce and Industry after the War: A General Committee.**—We already have a number of Board of Trade Committees investigating the steps that are to be taken for the assistance of particular trades after the war. We have also had the Economic Conference of the Allies and its important conclusions. It is now announced that the Prime Minister has appointed a Committee to consider the commercial and industrial policy to be adopted after the war, with special reference to the conclusions reached at the Economic Conference of the Allies, and to the following questions:—

(*a*) What industries are essential to the future safety of the nation; and what steps should be taken to maintain or establish them?

(*b*) What steps should be taken to recover home and foreign trade lost during the war, and to secure new markets?

(*c*) To what extent, and by what means, the resources of the Empire should, and can, be developed?

(*d*) To what extent, and by what means, the sources of supply within the Empire can be prevented from falling under foreign control?

The Committee is composed as follows :—

The Right Hon. Lord Balfour of Burleigh, K.T., G.C.M.G. (chairman).

| | |
|---|---|
| Mr. Arthur Balfour. | Sir A. Mond, Bt., M.P. |
| Mr. H. Gosling. | Mr. Arthur Pease. |
| Mr. W. A. S. Hewins, M.P. | Mr. R. E. Prothero, M.P. |
| Mr. A. H. Illingworth, M.P. | Sir Frederick H. Smith, Bt. |
| Sir J. P. Maclay, Bt. | Mr. G. J. Wardle, M.P. |

Together with the following gentlemen, who are presiding over Board of Trade Committees on the position of important industries after the war :—

| | |
|---|---|
| Sir H. Birchenough, K.C.M.G. | Sir C. A. Parsons, K.C.B., F.R.S. |
| Lord Faringdon. | Lord Rhondda. |
| Sir C. G. Hyde. | Mr. G. Scoby-Smith. |

Mr. Percy Ashley, of the Board of Trade, and Mr. G. C. Upcott, of the Treasury, have been appointed secretaries to the Committee.

**Women in Sub-Stations.**—The accompanying illustration shows a female sub-station attendant at work in the Dudley sub-station of the Shropshire, Worcestershire and Staffordshire Electric Power Co. Several women are employed on this work by the company. For some time past the Glasgow Corporation electricity department has employed women on similar duties, and it is understood that in both places they have proved very satisfactory

operators. They have been trained also as switchboard attendants for generating stations.

A correspondent in this issue points out that such work is admirably adapted for disabled soldiers and sailors : we believe that up to the present the latter have had no difficulty in obtaining employment, but we cannot hope that this happy condition will be maintained for long, and, as we stated in our last issue under "War Items," p. 40, a Committee of the Institution of Electrical Engineers has made arrangements for training them to undertake such duties. We have no doubt that disabled fighting men will be employed in preference to women whenever they are available.

**Our Contemporaries "Caught Napping."**—An amusing paragraph appears in the *Electrical Times* of yesterday, in which our contemporary says : "We may as well own up to it first as last, they [the Council of the I.E.E.] have caught us napping. Neither is it a legitimate excuse that they caught our contemporaries napping also. They made a highly interesting announcement in the *Journal*, and for a whole week few of the electrical editors even saw it." The reference is to the recommendations recently submitted to the Electrical Trades Committee of the Board of Trade on behalf of the Council by the President, Mr. C. P. Sparks. So far from being "caught napping," we saw the announcement in the "Institution Notes" within five minutes of receiving the *Journal*, and in our issue of July 7th we published the whole of the recommendations, and congratulated the Council upon the new spirit by which it was animated (Elec. Rev., July 7th, p. 17). In the following issue we made the recommendations the subject of our leading article, and commented upon the fact that none of our contemporaries had referred to them at all. But what was more remarkable was that, even then, the only one of our contemporaries which awoke to their publication was *Electrical Industries*, and we have reason to believe that we were instrumental in directing its attention to the matter.

Now, after we have twice covered the ground, the *Electrical Times* brazenly alleges that the Council "caught our contemporaries napping"!

**Educational.**—In the House of Commons on Tuesday last, Mr. A. Henderson stated that it had been decided to appoint three committees, to inquire respectively into the education of young persons after the war, and the position of science and modern languages in our educational system. In the course of the debate which followed, the general desire for educational reform was manifest.

**Volunteer Notes.**—1st London Engineer Volunteers.—Headquarters, Chester House, Eccleston Place. Orders for the week by Lieut.-Col. C. B. Clay, V.D., Commanding.

*Saturday*, July 22nd.—Instructional Class, 2.30, Company Commander Fleming.

*Monday*, July 24th.—Technical for Platoon No. 9, 46, Regency Street, S.W. Squad and Platoon Drill, Platoon No. 10. Signalling Class and Recruits.

*Tuesday*, July 25th.—Officers' Instructional Class, 6-7. Recruits, 7-8. Lecture, 7.15. Lantern Lecture by Mr. W. Aitken : "Telephones."

*Wednesday*, July 26th.—Platoon Drill for No. 2 Platoon.

*Thursday*, July 27th.—Platoon Drill, No. 6 Platoon. Recruits, 5.45-7.45. Instructional Class, 5.45.

*Friday*, July 28th.—Technical for No. 10 Platoon, 46, Regency Street, S.W. Squad and Platoon Drill, No. 9 Platoon.

*Saturday*, July 29th.—Parade Headquarters, 2.45, for Company Drill. Uniform.

*Sunday*, July 30th.—Entrenching duties. Parade, Victoria (S.E. and C. Railway Booking Office), 8.40 a.m.

Macleod Yearsley, *Adjutant*.

*July 17th*, 1916.

**London Electricians' Wages Advanced.**—Electricians in the London district have been awarded an advance of ½d. per hour by the Committee on Production.—*Times*.

**Appointments Vacant.**—Senior shift engineer for Birmingham electricity department (£130). See our advertisement pages to-day.

**Memorial to Prof. Thompson.**—As we go to press, we have received the following letter :—

"Suggestions have been made in several quarters that a memorial to the late Prof. Silvanus P. Thompson should be established. I have to inform you that the Finsbury Technical College Old Students' Association have taken the matter up, and are now engaged on the formulation of a scheme to enable all those interested to perpetuate the memory of the deceased in a suitable manner.

"John E. Raworth.
"*President, the Finsbury Technical College Old Students' Association.*"

## OUR PERSONAL COLUMN.

*The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* Electrical Review *posted as to their movements.*

**Central Station and Tramway Officials.**—Mr. C. W. Shepherd, late general manager of the Edinburgh & District Tramways Co., Ltd., who has recently been acting as secretary, has, owing to ill-health, resigned his position with the company. Mr. J. Wiseman, who has been with the company for over 30 years, has been appointed to succeed him.

**General.**—Mr. Heathman, of Parson's Green, Fulham, wishes his correspondents to kindly take notice that there is not a second "N" to his name, as he is not a German. His antecedents for the past 300 years were Devonshire folk.

*London Gazette* notice.—Territorial Force. *London Electrical Engineers* : Sergeant C. L. Palmer, from R.E., to be Second-Lieutenant (on probation).

At the University Court of Edinburgh last week, Sir J. A. Ewing, Director of Naval Education, who was recently elected principal, was installed as head of the University Court.

Mr. H. V. Henniker, engaged at Edinburgh with Messrs. Bruce Peebles & Co., Ltd., was married at Ramsgate, on July 11th, to Miss K. Riches. The presents included a canteen of cutlery from the staff of Messrs. Bruce Peebles & Co., Ltd.

**Roll of Honour.**—Captain David D. Horne, who has fallen in action in France at the age of 40, was the representative at Newcastle-on-Tyne of Messrs. Crompton & Co., Ltd.

Captain George Clifford Whitaker, the youngest son of Mr. Matthew Whitaker, railway contractor, who is reported as killed in action whilst serving with the Leeds "Pals'" Battalion, was, on his next leave, to have married Miss Mary Hamilton, youngest daughter of Mr. J. B. Hamilton, the general manager of the Leeds Corporation tramways.

Corporal Walter Hutchinson, of the Bradford "Pals," who has been wounded, was an assistant engineer at the Batley Corporation electricity works prior to joining the Army.

Lance-Corporal Jack Rae, of the King's Own Yorkshire Light Infantry, who is severely wounded, was an apprentice to electrical engineering with Mr. Fisher, of Doncaster.

Private William Russell, of the West Yorks. Regiment, who is wounded and in a Bristol hospital, was formerly employed at the Bradford electricity works.

Second-Lieutenant Jack M. Clarke, Royal Irish Rifles, wounded, is a son of Canon Clarke, Killead, Ireland, and is an electrical engineer.

Signaller Vincent Cure, of the Bradford "Pals," who has died of wounds, was an employé at the Bradford telephone headquarters.

Lance-Corporal William Gibson, of the Lonsdale Battalion, Border Regiment, who was killed in action on July 1st, was, before the war, an electrician in the employ of the Windermere & District Electricity Supply Co., Ltd.

Amongst those wounded in the fighting in France is Lieutenant R. E. Bullough, of the South Midland Royal Engineers, son of Mr. R. C. Bullough, manager of the Colchester tramways.

Lance-Corporal Wilfred Waterman, of the Essex Regiment, who has fallen in action during the advance in France, was, before the war, engaged at the Chelmsford works of the Marconi Co.

Private Eric F. Smith, of the East Yorkshire Regiment, who is in hospital at Rouen seriously wounded, was, before the war, on the electrical engineering staff of Henley's Telegraph Works Co.

Private H. W. Fraser, of the London Scottish, who was, on his enlistment, in the electricity department of the Woolwich Corporation, has been wounded.

Sergeant F. F. Robson, of the 2nd Coldstream Guards, who was on the staff of the Hull Corporation Tramways, has gained the Military Medal for gallant conduct on the field.

Private Frank Price, of the Royal Fusiliers, who was with the Electric Construction Co., of Bushbury, Wolverhampton, before the war, has been wounded in France.

Sergeant C. H. Smith, of the Devonshire Regiment, who was on the staff of the Electric Light Co., at Barnstaple, has been wounded, and is in a hospital at Birmingham.

Second-Lieutenant Jinks, of the Northants Regiment, who has been wounded in France, was an engineer in the test department at the Rugby works of the British Thomson-Houston Co., Ltd. Before being wounded he was in the enemy lines with his two machine guns for a day. He is in the Duchess of Westminster's Hospital at the base.

Private W. J. Baker, of the 7th South Staffs. Regiment, officially reported killed in action, after being missing since August 9th last, was, before his enlistment, engaged with the British Thomson-Houston Co., Ltd., of Rugby.

Rifleman Harry King, of the Rifle Brigade, who was, prior to the war, with the British Thomson-Houston Co., Ltd., at Rugby, has been wounded.

Gunner Spencer Milan, of the Royal Field Artillery, who has died of double pneumonia, contracted in training, was an electrician in the employ of Mr. Guy Laycock, of Huddersfield.

Private C. H. Long, of the West Yorks. Regiment, who is wounded, was formerly employed at the Bolton Road electricity works, Bradford.

Private Bert Robinson, an employé of the Lancashire Dynamo & Motor Co., Ltd., Trafford Park, has been wounded.

Sergeant Walter A. Chadwick, killed in action, was formerly a costs clerk employed by Messrs. W. T. Glover & Co., of Trafford Park. Private T. Horrocks, an employé of the same company, has been wounded.

Lance-Corporal E. H. Holme, for many years in the employ of the British Westinghouse Co., Trafford Park, is unofficially reported killed. Private Joseph Ackerley, another employé of the company, has also been killed in action.

Private F. Horrox, wounded and in hospital at Glasgow, was an employé of the Lancashire Dynamo & Motor Co., Ltd., Trafford Park.

Private James Gillow, of the Royal Warwicks, formerly employed by the British Westinghouse Co., Trafford Park, has been killed in action.

Private A. Singleton, who has been wounded, was formerly employed by Messrs. Baxendale & Co., Ltd., of Manchester.

Private John McGuire, a former employé of Messrs. Saunders & Taylor, Ltd., electrical engineers, Manchester, is reported killed.

Private S. Needham, an employé at the British Westinghouse Works, Trafford Park, has been killed in action.

Private Herbert Smethurst, who has died in hospital at Rouen from wounds, was an employé at the Chloride Electrical Storage Works, Clifton Junction.

Cyclist H. R. Bates, an employé of the British Westinghouse Co., Trafford Park, has been wounded.

Private C. Kenny, of the South Lancashire Regiment, and his brother, Private L. Kenny, of the Manchester Regiment, both of whom were employed by the British Westinghouse Co., have been wounded.

Company-Sergeant-Major Harry Gill, West Yorkshire Regiment, an electrical engineer, of Leeds, who was wounded on the first day of the recent advance, died two days later.

The *Times* states that Captain Norman Vaudrey, Manchester Regiment, killed on July 1st, in his 32nd year, was the second and only surviving son of Sir William and Lady Vaudrey. Captain Norman Vaudrey was a civil engineer at Manchester.

Major W. A. Vignoles, borough electrical engineer of Grimsby, has been wounded in the left hand, and is in hospital in London.

Private E. O. Williams, of the West Yorks. Regiment, who is wounded, was in the electric lighting department at Leeds.

Private E. Gledhill, wounded whilst serving in the West Yorks. Regiment, was in the Bradford tramways department.

Lieutenant W. C. McConnell, Royal Irish Rifles, officially reported killed in action on July 8th, was the youngest son of Sir Robert McConnell, Bart., D.L., Strandtown, Belfast, and was a partner in the firm of McConnell & Bailey, mechanical and electrical engineers, London, E.

The *Times* reports the death from wounds, on Tuesday, of Second-Lieutenant F. R. Hoggett, A.M.I.E.E., Royal West Surrey Regiment, aged 29, who had been connected with Callender's Cable & Construction Co., Ltd.; also the death of Lieutenant Eric B. R. Scott, R.E., a student of the Royal School of Mines, South Kensington, aged 20, who joined the London Electrical Engineers (T.F.) at the outbreak of war; also of Second-Lieutenant Noel D. Edinborough, Middlesex Regiment, aged 22, who was an Associate of the Institution of Electrical Engineers and of the City and Guilds of London Institute.

Private Frank Tyson, an employé of the British Westinghouse Co., Trafford Park, has been wounded.

Private Herbert Whitney, of the Cheshire Regiment, who has been killed in action, was formerly employed in the electricity department of the Sale (Cheshire) District Council.

Private Edward Millar, formerly on the staff of the Manx Electric Railway Co., has been killed in action in France, where has was serving with the Canadian Contingent.

Captain Alfred Lee Wood, to whose death in action in France we referred last week, was a brother of Mr. Arthur P. Wood, general manager and director of the Lancashire Dynamo and Motor Co., Ltd. Captain Wood, who was on the staff of the same company for some years, and had represented it in India, was a son of the late Mr. J. Lee Wood, for many years secretary of the Clifton & Kearsley Coal Co., Ltd. He was given a commission as lieutenant in the Lancashire Fusiliers in October, 1914, was afterwards raised to a cap-

The Late Captain Alfred Lee Wood.

taincy, and went out to France last November. A Manchester paper gives the following account by his orderly, who lies wounded at Manchester, of the way in which the gallant officer met his death:—

On the morning of the attack our guns began a heavy bombardment at 6.30, and continued for an hour. About an hour later the captain was standing below the parapet calmly smoking a cigarette and glancing occasionally at his wrist watch. At 7.30 sharp he leapt over the parapet, followed by his men. A perfect tornado of bullets was encountered from every side. Barely 50 yards had been covered when he was hit by a bullet which grazed his head, whilst I got one in the arm. Without pausing we went on a little further, when a second bullet struck the captain on the head, causing a nasty gash, and almost at the same moment I was shot through the leg. Turning to me, the captain asked, "Are you badly hit?" and I replied, "Yes, sir, I can't go on this time." He then ordered me to try and get back to our trench, and although I begged him to come back with me, as he was badly wounded, he said, "No, I will get that machine gunner." The gun was causing fearful losses amongst his men. The machine gun was taken later, and it was found that the man working it was chained to it and wearing an Iron Cross. . . . . I heard that the captain reached the third line of German trenches before receiving his third and fatal wound. I managed to get my leg dressed, and later on saw the captain lying in our trenches, with the Colonel by his side. He was known to us as the "gaffer," and we would have followed him anywhere.

## CITY NOTES.

**General Electric Co., Ltd.**

The annual meeting was held at the Cannon Street Hotel, E.C., on Monday, under the presidency of Mr. H. Hirst, chairman and managing director. Mr. Hirst said that the outstanding features of the balance sheet were that they had made a net increased profit of nearly £31,000, that they had spent, roughly, £80,000 in works extensions, that they had been able to carry on their increased business and yet keep the large sum of £252,000 invested in War Loan and Treasury Bills, and, finally, that their proposed appropriation provided for an increase to the reserve fund of £40,000, and an increased carry-forward of £11,000. All the other figures were substantially of the same character as those of a year ago. The distribution on the ordinary shares was the same as last year. Dividends absorbed a slightly larger amount, namely, £92,000, instead of £87,000. The advance shown was all the more remarkable as a great portion of the previous year's output was for Government requirements, and the prices charged were, almost without exception, the same as those ruling prior to the war; only in certain cases had they asked for advances, and then only in proportion to the increased prices of raw material and labour. The higher profits were mainly due to the fact that under present conditions they had obtained more repetition work than one could expect in normal times, and all engineering repetition work cheapened the cost of production, because they were able to get more work from the machines. They had benefited in some manufacturing departments which, under pre-war conditions, showed an annual loss, whilst under present conditions they had yielded a legitimate profit. He referred to some of the departments which had been adversely criticised on previous occasions, but which had proved of exceptional value to the Government. The shell factory which they had laid down was now in full swing, and had been responsible for a considerable proportion of last year's capital expenditure. At the first starting up, some temporary dislocation was caused in the works owing to the necessity of training women and unskilled labour with a depleted staff, and, perhaps, owing to want of experience in this direction on this company's part. Their deliveries had given the greatest satisfaction, but they had not yet succeeded in making a profit in this section of the works. Their large reserve stock of standard lines had naturally benefited by the general rise in prices, and this had been a contributory factor to the success of the year. Above all, their results were mainly due to the loyalty, co-operation, and resourcefulness of the staff and the majority of the workpeople, who had appreciated the utility of their products to the country. A goodly number would not be lured away into the many concerns started since the war, which temporarily were offering such tempting and abnormal wages. All the work which they had done did not show itself in actual business returns. Many of their people had been able to devise, and give useful assistance to, Government departments and committees in experiments, and in the solution of scientific problems which the conditions of war had created. This was not a time for thinking of larger dividends. With the ever-increasing difficulty of obtaining raw material, the probable further diminution in the supply of labour, and the necessary limitation to imports and exports, it was impossible to forecast what surprises might be ahead of them before the war was over. They must, therefore, persevere in the policy of conserving their strength and keeping their assets liquid. They must bear in mind, also, that a big task confronted the electrical industry in this country. Much was expected of them, and they, the General Electric Co., were anxious to fulfil these expectations. As soon as they had the slightest indication as to what would be the Government policy after the war, and in what way new enterprises would receive the necessary measure of Government assistance which present conditions demanded, they would be willing to open up in new fields and avenues which had hitherto been closed to the manufacturers of this country. The stronger they made themselves internally, the more fit they would be to wage the fierce commercial and industrial contest which was bound to ensue after the war, and the better would they be able to make use of the opportunities held out to the electrical industry by the Allies. Their strong financial position and reserves would permit them to go full speed ahead with the constructional work, and their sales organisations overseas were so unique and firmly established that they were prepared for any challenge. It was just this desire to keep their oversea branches alive and well organised that was causing them anxiety, as export business was now rendered so difficult, due to lack of tonnage, and they were consequently able to execute only a small percentage of the orders and contracts which they were offered. Where an industry never seemed to get out of the state of evolution, the directors and managers could not keep pace with the times if, with every experiment and with every fresh step involving expense, they were to feel that they were incurring expenditure which might deprive the shareholders of their dividends for the current year. If a portion of the past profits were always available for pioneer work, for testing, sounding and studying new inventions, and investigating fresh fields of inquiry, one had the greatest chance of remaining at the top of the industry. As regarded investments, they were committed to a policy, and, according to the present plans of the board, the investment account was likely to be still further increased next year. He presumed, however, that so long as this account showed a handsome yield, the shareholders would encourage them to go ahead. They had given a full account of their investments, and would continue to do so in the future with the same frankness. Through one of their associated companies, the Peel-Conner Telephone Works, they had now established a magneto factory near Coventry. Under the title of the Conner Magneto Ignition, Ltd., that company had evolved a magneto for which Government contracts had already been secured. The works had been started on quite a considerable scale, and they hoped within a very few months to be able to make good some of the present deficiency in the supply of so important and essential an appliance. Conditions of war made it impossible to discuss fully and thoroughly all the various operations in which they were engaged, but if, after the cessation of hostilities, this ban was removed from his lips, he would be able to tell such a story of G.E.C. war activities as might well fill both the shareholders and the staff with pride. Their labour and resources were being, and would continue to be, used to the utmost to further the end they all had in view, namely, complete victory. No fewer than 52 of their men had laid down their lives, 133 had been wounded, 61 had been invalided, and four were either missing or prisoners of war. This was indeed a heavy casualty list out of a total of 1,500 men who had joined the Forces. It could be better understood, however, when it was remembered that most of their men joined at the commencement of hostilities. The company would endeavour, as far as lay in their power, to help the dependents of the fallen. They had created a complete scheme for regularly communicating with and supplying comforts to those serving at the Front, and they fervently hoped that, at a not far distant date, they might see them back again at their old places in the firm.

Mr. Ernest Byng seconded.

Mr. Walker thought they were entitled to get as much information as could properly be given to cover the question of what was going to be done, in view of the fact that, roughly, £80,000, or considerably more than the amount of their profits, had been expended in works extensions. He would like to know whether that money had been spent in order to place the company in a position of only doing work for the Empire during the present time of stress. They must bear in mind that the Government were taking 50 per cent. of their excess profits, which was to be increased to 60 per cent., and eventually, he believed, to 95 per cent. He thought such a policy would have the effect of driving industries from this country to America and other neutral countries, where they would not contribute 50 or 60 per cent. of their excess profits to the Chancellor of the Exchequer. He was a director of a small company which did not pay any profit until 1914, and then it made a profit of £2,600. Then followed the war, and because the balance sheet of that company was made up after July 31st, 1914, they were asked to contribute half of their profits to the National Exchequer, whereas if the balance sheet had been made up before July 31st, 1914, they would have contributed nothing. At the same time, their profits had nothing to do with war profits, but were made before the war started.

Dr. Moody congratulated the directors upon being able to present a balance sheet showing such large liquid reserves. After two years of war, it showed the company was well managed, and that they had sufficient resources to carry through any enterprise they might undertake.

The Chairman said he sympathised with Mr. Walker in what he had said. In the electrical industry they turned out products of both peace and war, and both those classes of products could be turned out from the same machines with but slight alterations. With regard to the £80,000 they had spent in extensions, a very large proportion of that expenditure would be useful to them, after Peace was declared, in the development of their business. Some portion of the money, of course, would be useless from the commercial point of view after the war was over, but no doubt the Government would have to consider the position of firms who had sunk much more capital than they had done for war-work purposes, and no doubt they would be treated with equal consideration by the Government. He thanked Dr. Moody for his kind comments, which were very encouraging.

The motion was carried unanimously, and the dividend declaration was approved.

The Chairman said he had now to propose that the appointments of Mr. M. F. Armstrong, Mr. G. H. Ide, and Mr. M. Solomon as directors of the company be confirmed. He was glad Mr. Armstrong had accepted their invitation to join the board. He had known him for a great many years, and he had always shown great interest in their work. He had all those qualifications which would make him very useful—in fact, he might say eminently useful—to the company, and he hoped the shareholders would approve of his selection. Mr. Solomon, the manager of their carbon works, was unable to be with them that day, but he had been associated with the company for upwards of 14 or 15 years, and Mr. Ide, the manager of their metal works, had been with them for upwards of 20 years, and he was sure they would prove two very valuable additions to their board.

Mr. M. J. RAILING seconded, and the motion was carried.

The CHAIRMAN proposed the re-election of Mr. E. H. Byng, who took a very great interest in their company, but, unfortunately, had suffered from ill-health. He was with them that morning, and he hoped he would shortly be able to resume work.—This was carried.

**Mexican Companies.**

A joint meeting of the holders of the bonds issued by the Mexico Tramways Co., the Mexican Light & Power Co., Ltd., the Mexican Electric Light Co., Ltd., and the Pachuca Light & Power Co. was held last week in London, to decide upon the policy to be adopted for the protection of the bondholders' interests until conditions in Mexico improve. The matter has been fully reported in the financial dailies. Mr. W. E. Rundle, general manager of the National Trust Co., Ltd. (the trustee for the bondholders), who presided, said that the total bonds outstanding, including all the issues, was £12,330,371. Of this amount £9,074,020 had been deposited with the committee, representing 73.75 per cent. of the total outstanding issues. From the time defaults were first made by the companies in payment of interest the trustee was impressed with the necessity of obtaining as soon as possible an independent report upon the properties. It was recognised that the default had not been brought about through bad management, but owing to conditions wholly beyond the control of the directors and the executives of the companies. Nevertheless, it was deemed advisable to secure independent advice. In February last the trustee, in conjunction with the receiver of the Mexican Light and Power Co., and the directors of the other companies of the group, induced Mr. Phippen and Mr. Trowbridge, a former manager of the Light & Power Co., to proceed to Mexico. After a study of the position and conditions of the companies, and after carrying on certain negotiations with the Government and others, they returned to Toronto and made to the National Trust Co. the report which was in the hands of the bondholders. Substantial results were obtained by their representatives. He strongly emphasised the necessity for the bondholders of all the companies of the group to stand together at this time for mutual protection. In this was the hope for the future. The circumstances and conditions were most unusual, and unless they were met in a broad, strong, and courageous manner the bondholders' interests, in his opinion, would undoubtedly suffer, if not end in catastrophe. He moved a resolution approving of the resolutions intended to be proposed at the formal meetings of the bondholders and recommending that such resolutions be passed.

Mr. E. R. PEACOCK (chairman of the Bondholders' Protection Committee), in seconding the resolution passed by the Chairman, said that Mr. Rundle had emphasised what the committee regarded as the most important point, namely, the necessity for single control and management of the companies during the troubled period in Mexico. That involved that someone should have full power of action, and in the present circumstances of the companies obviously that power should rest with the bondholders. The bondholders had by a very large majority relegated their powers to the bondholders' committee, and the resolutions directed the committee to take such steps as they found necessary to ensure that they had that control.—The resolution was carried unanimously.

**Crompton and Co., Ltd.**

For the year ended March 31st, 1916, the gross profit was £63,118, and after deducting general charges, depreciation, interest on debentures, and other items, there remains, including the sum brought forward, an available balance of £37,950. Out of this, £6,500 is to be put to general reserve, £10,000 to special depreciation account, £1,608 is written off the balance of preliminary expenses, 7 per cent. is paid on the preference shares, requiring £9,363, and £10,479 is to be carried forward, subject to excess profits tax and to assessment under the Ministry of Munitions Act, 1915. In view of the last-named liabilities, the directors do not deem it prudent to recommend a dividend on the ordinary shares. Mr. T. Britten, manager of the works at Chelmsford, has been elected to the board. Annual meeting: July 24th.

For the previous year the gross profit was £57,911. £6,500 was put to general reserve, £3,500 to special depreciation account, £1,608 was written off preliminary expenses, 7 per cent. was paid on the preference shares, and £7,691 was carried forward.

**Liverpool Overhead Railway Co.**—Interim dividend to June 30th, on account of the year ending December 31st, 1916, at the rate of 5 per cent. per annum on the preference shares, and 2½ per cent. per annum on the ordinary shares. Income-tax will be deducted at the rate of 4s. 6d. in the £.

**To be Struck Off the Register.**—The following companies will be struck off the register within three months and dissolved unless cause is shown to the contrary:—

Atlas Anti-Friction Metal Co.
Eclipse Rail-Track Co.
Electric Ozone Syndicate.
Traffic Indicators, Ltd.
Wireless Electric Light Co.

**Sao Paulo Tramway, Light & Power Co.**—Dividend, 2½ per cent. on the common stock.

**Rio de Janeiro Tramway, Light & Power Co.**—Dividend, 1½ per cent. on the capital stock.

**Brazilian Traction, Light & Power Co.**—Dividend, 1 per cent. on the ordinary stock.

**Veritys, Ltd.**—By an Order of the Court, separate meetings of the holders of the ordinary shares and of the management shares respectively are to be held on July 25th, to consider a scheme of arrangement between the company and such holders. The Court has appointed Mr. G. Verity, or failing him Mr. B. C. Evans, as chairman of the meetings, and he has to report the result to the Court. A copy of the scheme can be seen at the office, 31, King Street, W.C., by arrangement.

## STOCKS AND SHARES.

TUESDAY EVENING.

The cheering news from the Front has been hailed with delight in the City, where there is keen appreciation of the first fruits of the Great Offensive. This encouragement compensates for an unexpected advance in the Bank Rate to 6 per cent.—the first change since August 8th, 1914. The reason for this step is taken to be due to financial conditions in New York, and criticism hesitates to say much on a subject of which the essential elements can be known only to the Bank of England and a few other authorities.

Naturally, the rise caused a sharp set-back in Stock Exchange prices. Perhaps the previous upward movement had rushed ahead too sharply, and reaction was fairly due. Reaction came, anyway, and most of the investment prices are down on the week. Even the profit-makers out of the war are not likely to buy Consols on a 4¼ per cent. basis when they can get Treasury Bills of the British Government to pay them £6 7s. 8d. per cent. on the money, and War Expenditure Certificates that return 6 per cent.

The Home Railway market was amongst the first to suffer. Gilt-edged stocks fell back one to three points, and the eager demand for them became abated. This was quickly reflected in the ordinary stocks, which gave way without exception. At the lowered levels, however, evidence of bargain-hunting appeared. The argument revived that investment requires a more permanent home for its money than is provided by the short-term policy of war finance to which the Treasury seems so greatly wedded. Before the month is out, we make bold to prophesy people will have become familiarised with a 6 per cent. Bank Rate, and will be buying previous favourites in the Stock Exchange markets. Always provided, of course, that the Bank Rate is not put up further.

The Stock Exchange Committee have under active consideration a scheme for restoring, where practicable, double quotations, officially, for stocks and shares dealt in through the markets. This will come into operation in a month's time, according to present intentions. One of the chief difficulties of re-establishing double prices is aptly furnished by the market in electricity supply shares.

At the present time, there is a pronounced scarcity of supply. Shares can be sold with comparative ease, but they cannot be bought in a number of cases. The jobbers may say, therefore, that to quote a price at 6½ to 7 in the Official List is misleading and unreliable if they have no shares to offer at 7. Probably the position would be the same if they called the price 6½ to 7½, when they would incur the charge of quoting an absurdly wide margin between buyers and sellers. Where a free market exists, reversion to the double prices could be reliable and valuable. What will happen, we take it, is that a start will be made with certain stocks and shares, leaving blanks for a great many others, and these latter would gradually come into line as business in them developed enough for double prices to be accurately and reliably quoted.

Underground Electric Incomes dropped 3½ of their previous week's gain of 4 points. The shares are also down. Metropolitans shed 1½ and Districts lost ¾. South-Western deferred, which shot up to 27¾ on the excellent results which electric traction is said to be affording the company, reacted to 26.

Electricity Supply shares are amongst the few to which the 6 per cent. Bank Rate made no difference. Charing Cross preference are 5s. up, and so are City of London ordinary. The reason is the same as that already mentioned, namely, that there are no shares on offer. Neither the rise in the Bank Rate nor that in the price of coal brought in any sellers of the shares.

The Telegraph market is equally firm. Several stocks from which dividend payments were deducted last week have begun to recover the amounts. Chile Telephones are a particularly good spot, again putting on 3/16 with a rise of 7, so that they are the fraction higher than United River Plate Telephones, with which previously they had been keeping in step. Marconis experienced a swift drop to 3 1/16 on a shake-out of the bull position. From this there was something of a rally, but the price is still down on the week, and with it there subsided also the American, Canadian, and Spanish shares, these dropping abruptly to 17s. 6d. for the first, and half-a-guinea for the two others.

Bondholders of the four principal Mexican Utilities companies met last week to consider what policy should be adopted for the protection of their interests until conditions in Mexico improve. The meeting was an informal one, but informing details were given, and the importance emphasised

of all the bondholders standing together at this crisis. Further meetings are to be held in about six weeks' time. Meanwhile, rumour has since been busy with a report, made in America, that the United States has offered President Carranza financial assistance in restoring order provided that he agrees to certain terms. Prices of the various bonds are none too firm, but the first mortgage bonds of the Light and Power have been dealt in lately on the basis of 41.

In spite of the declaration of a 1 per cent. dividend, Brazilian Tractions are dull and heavy at 62. The Anglo-Argentine Tramways group shows no change. Alabama Traction Light & Power shares rose to 32, but gave way afterwards to 29. The report states that the net revenue for 1915 came to $569,000, which is just about double that for the previous twelvemonth. City Services shares came down from 385 to 340 on New York selling.

The Sao Paulo Tramway, Light & Power announces a dividend of 2¼ per cent. on its common stock, and the Rio Tramway a dividend of 1¼ per cent., both payable on August 1st.

British Westinghouse preference are a strong spot with a jump of 2s. 6d. to 51s. 6d. The shares, of course, are 15 per cent., but at present receive 7½ per cent. They are non-cumulative. British Insulated improved upon their previous week's advance of 15s. with a rise of 5s., which brought them to 11½. General Electrics are steady, on the meeting. Henleys rose to 15½, Electric Constructions to 16s. 3d. Other industrials remain firm as a whole. The rubber market pursues a humdrum way, the price of the material keeping about 2s. 3d. per lb. No decision has yet been arrived at as to the basis upon which the younger producers will be assessed for excess profits tax.

## SHARE LIST OF ELECTRICAL COMPANIES.

| | Dividend 1914. | Dividend 1915. | Price July 18, 1916. | Rise or fall this week. | Yield p.c. |
|---|---|---|---|---|---|
| **HOME ELECTRICITY COMPANIES.** | | | | | |
| Brompton Ordinary | 10 | 10 | 6⅔ | — | £7 18 2 |
| Charing Cross Ordinary | 5 | 5 | 8⅜ | — | 6 18 0 |
| do. do. do. 4½ Pref. | 4½ | 4½ | 8½ | + ¼ | 6 8 7 |
| Chelsea | 5 | 4 | 8 | — | 6 18 4 |
| City of London | 9 | 8 | 12½ | + ¼ | 6 8 0 |
| do. do. 6 per cent. Pref. | 6 | 6 | 10½ | — | 5 14 3 |
| County of London | 7 | 7 | 10⅝ | — | 6 11 9 |
| do. 6 per cent. Pref. | 6 | 6 | 10⅝ | — | 5 15 8 |
| Kensington Ordinary | 9 | 7 | 5⅛ | — | 6 16 7 |
| London Electric | 4 | 3 | 1½ | — | 7 5 5 |
| do. do. 6 per cent. Pref. | 6 | 6 | 4¼ | — | 6 13 4 |
| Metropolitan | 3½ | 3 | 2⅜ | — | 6 6 4 |
| do. 4½ per cent. Pref. | 4½ | 4½ | 8 | — | 7 10 0 |
| St. James' and Pall Mall | 10 | 8 | 6 | — | 6 13 4 |
| South London | 5 | 5 | 2⅞ | — | 8 18 10 |
| South Metropolitan Pref. | 7 | 7 | 1¼ | — | 8 4 5 |
| Westminster Ordinary | 9 | 7 | 6½ | — | 5 14 3 |
| **TELEGRAPHS AND TELEPHONES.** | | | | | |
| Anglo-Am. Tel. Pref. | 6 | 6 | 104xd | — | 5 15 5 |
| do. Def. | 80/- | 83/6 | 23 | — | 7 10 9 |
| Chile Telephone | 8 | 8 | 7 | + 3/16 | 5 14 5 |
| Cuba Sub. Ord. | 5 | 5 | 7⅛ | — | 6 18 4 |
| Eastern Extension | 7 | 8 | 1 5/8xd | — | *5 7 8 |
| Eastern Tel. Ord. | 7 | 8 | 149xd | — | *5 7 8 |
| Globe Tel. and T. Ord. | 6 | 7 | 121xd | — | *5 8 8 |
| do. Pref. | 6 | 6 | 111xd | — | 5 9 1 |
| Great Northern Tel. | 22 | 22 | 38 | — | 5 18 0 |
| Indo-European | 13 | 13 | 48 | — | 6 19 8 |
| Marconi | 10 | 10 | 8½ | — 3/32 | 3 4 0 |
| New York Tel. 4½ | 4½ | 4½ | 102½ | — | 4 7 10 |
| Oriental Telephone Ord. | 10 | 10 | 2 | — | 5 0 0 |
| United R. Plate Tel. | 8 | 8 | 6 13/16 | — | *5 17 5 |
| West India and Pan. | 1 | — | 1⅛ | — | — |
| Western Telegraph | 7 | 8 | 15 xd | — | *5 6 8 |
| **HOME RAILS.** | | | | | |
| Central London, Ord. Assented | 4 | 4 | 78 | — | 5 9 7 |
| Metropolitan | 1½ | 1 | 26 | — 1½ | 3 17 0 |
| do. District | Nil | Nil | 19 | — ¾ | Nil |
| Underground Electric Ordinary | Nil | Nil | 1 15/16 | — 1/16 | Nil |
| do. do. "A" | Nil | Nil | 6/8 | —6d. | Nil |
| do. do. Income | 6 | 6 | 88 | — 3½ | *6 16 2 |
| **FOREIGN TRAMS, &c.** | | | | | |
| Adelaide Sup. 6 per cent. Pref. | 6 | 6 | 5 | — | 6 0 0 |
| Anglo-Arg. Trams, First Pref. | 5½ | 5½ | 8¼ xd | — | 7 2 0 |
| do. 2nd Pref. | 5½ | 5½ | 3½ | — | 8 9 2 |
| do. 5 Deb. | 5 | 5 | 77½ | — | 6 9 0 |
| Brazil Tractions | 4 | 4 | 62 | — 1 | 6 9 0 |
| Bombay Electric Pref. | 6 | 6 | 10⅛ | + ⅛ | 5 14 2 |
| British Columbia Elec. Rly. Pfce. | 5 | 5 | 60xd | — | 8 6 8 |
| do. do. Preferred | — | Nil | 40 | — | Nil |
| do. do. Deferred | — | Nil | 39 | — | Nil |
| do. do. Deb. | 4½ | 4½ | 65 | — | 6 10 9 |
| Mexico Trams 5 per cent. Bonds | — | Nil | 4½ | — | Nil |
| do. 6 per cent. Bonds | — | Nil | 34 | — | Nil |
| Mexican Light Common | Nil | Nil | 20 | — | Nil |
| do. Pref. | Nil | Nil | 33 | — | Nil |
| do. 1st Bonds | Nil | Nil | 42 | — | — |
| **MANUFACTURING COMPANIES.** | | | | | |
| Babcock & Wilcox | 14 | 15 | 3 | — | 5 0 0 |
| British Aluminium Ord. | 5 | 7 | 25/- | — | 5 7 8 |
| British Insulated Ord. | 15 | 17½ | 11½ | + ½ | 7 12 2 |
| British Westinghouse Pref. | 7½ | 7½ | 51/6 | + 3/8 | 5 16 3 |
| Callenders | 15 | 20 | 19½ | — | 8 0 0 |
| do. 5 Pref. | 5 | 5 | 4½ | + ½ | 5 11 1 |
| Castner-Kellner | 20 | — | 32 | — | 5 6 8 |
| Edison & Swan, £3 paid | Nil | — | 9/6 | —9d. | Nil |
| do. do. fully paid | Nil | — | 1½ | — | Nil |
| do. do. 5 per cent. Deb. | 5 | 5 | 57 | — | 8 15 8 |
| Electric Construction | 6 | 7½ | 16/3 | + 1/- | 9 4 8 |
| Gen. Elec. Pref. | 6 | 6 | 10 | — | 6 0 0 |
| Henley | 20 | 25 | 15½ | + ½ | 8 1 3 |
| do. 4½ Pref. | 4½ | 4½ | 4 | — | 5 12 6 |
| India-Rubber | 10 | 10 | 19½ | — | *3 3 4 |
| Telegraph Con. | 20 | 20 | 39xd | — | *5 4 0 |

* Dividends paid free of income-tax.

## MARKET QUOTATIONS.

IT should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

### Wednesday, July 19th.

| CHEMICALS, &c. | Latest Price. | Fortnight's Inc. or Dec. |
|---|---|---|
| a Acid, Oxalic per lb. | 1/8 | .. |
| a Ammoniac Sal per ton | £75 | .. |
| a Ammonia, Muriate (large crystal) " | £54 | .. |
| a Bisulphide of Carbon " | £23 | .. |
| a Borax " | £30 | .. |
| a Copper Sulphate " | £51 | .. |
| a Potash, Chlorate per lb. | 2/6 | .. |
| a " Perchlorate " | 2/- | .. |
| a Shellac per cwt. | 98/- | 3/- inc. |
| a Sulphate of Magnesia per ton | £18 | .. |
| a Sulphur, Sublimed Flowers " | £15 | £1 inc. |
| a " Lump " | £11 10 | 30/- inc. |
| a Soda, Chlorate per lb. | 1/4½ | .. |
| a " Crystals per ton | 120/- | .. |
| a Sodium Bichromate, casks per lb. | .. | .. |
| **METALS, &c.** | | |
| c Brass (rolled metal 2" to 12" basis) per lb. | 1/3⅜ to 1/3 | 1½d. dec. |
| c " Tubes (solid drawn) " | 1/3⅜ to 1/3 | 1d. dec. |
| c " Wire, basis " | 1/3 to 1/3½ | 1½d. dec. |
| c Copper Tubes (solid drawn) " | 1/5½ to 1/6½ | ½d. dec. |
| g " Bars (best selected) per ton | £146 | £6 dec. |
| g " Sheet " | £146 | £6 dec. |
| g " Rod " | £146 | £6 dec. |
| d " (Electrolytic) Bars " | £123 | £10 dec. |
| d " " Sheets " | £141 | £10 dec. |
| d " " Rods " | £130 | £10 dec. |
| d " " H.C. Wire per lb. | 1/3½ | ¼d. dec. |
| f Ebonite Rod per lb. | 3/- | .. |
| f " Sheet " | 2/6 | .. |
| n German Silver Wire " | 2/3 | .. |
| h Gutta-percha, fine " | 6/10 | .. |
| h India-rubber, Para fine " | 2/11 | 2½d. inc. |
| i Iron Pig (Cleveland warrants) per ton | Nom. | .. |
| l " Wire, galv. No. 8, P.O. qual. " | £86 | .. |
| g Lead, English Pig per ton | £29 5 | 5/- dec. |
| g Mercury per bot. | £17 12 6 to £17 15 | £1 inc. |
| e Mica (in original cases) small per lb. | 6d. to 8/- | .. |
| e " " " medium " | 8/6 to 6/- | .. |
| e " " " large " | 7/6 to 14/- & up. | .. |
| d Silicium Bronze Wire per lb. | 1/8½ | .. |
| r Steel, Magnet, in bars per ton | £85 | .. |
| g Tin, Block (English) " | £166 to £167 | £10 dec. |
| n " Wire, Nos. 1 to 16 per lb. | 2/10 | 2d. dec. |

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

**Registration of Firms Bill.**—Following up our recent reference to this subject in our leader columns (ELECTRICAL REVIEW, March 31st, p. 357), we are glad to learn that the Select Committee of the House of Lords, to which the Bill was referred, has reported, urging that it should be pressed forward without delay. That there was, and had long been, a public demand for the Bill was recognised when it was read a second time without a division. According to the *Financial Times*, the Committee thinks that the title of the Bill should be "Registration of Business Names," as the Bill is not confined to trading firms, but includes professional partnerships. The object of the Bill being to include not all partnerships, but only those where the style conceals the identity of the actual traders, the Committee thinks the most convenient limit would be expressed by requiring registration by all who do not use their true surnames to designate their business. It is true that the surname does not exhaust the trader's description, but it goes a long way towards it, and opens the path to further inquiry if necessary. Such a description covers the case of the small local traders who already use their actual surnames, or can very easily do so. It is very difficult to provide a means of enforcing registration which shall not be either ineffective or oppressive. The Committee, after much consideration, proposes that anyone coming within the Act who does not register shall be disabled from suing on a contract made while he is in default, but that the Court, in proper cases, shall be able to give relief from this disability. The Committee also thinks that the Board of Trade should have power to enforce by penalty registration by a person who comes within the Act. The Committee looks upon the proposed registration as by no means a large, expensive, or complicated operation. The details are left to be worked by rules of the Board of Trade. The Committee expresses its strong opinion that the Bill would be of special value under the conditions both of the warfare now prevailing and of the state of things which may be expected to arise immediately afterwards. Events have shown how desirable it would have been to have had at the beginning of the war, and still would be to have ready to hand, such information as this Bill provides, and without entering upon any controversial matter relating to trade after the war, it may be generally accepted that the identity of those concerned with trade will be in the future an element of the greatest importance.

## LABOUR AND INDUSTRY.

(*Continued from page* 32.)

We are at present the subjects of conflicting emotions. An urgent appeal from the Commander-in-Chief moves us to redouble our efforts for turning out abundant supplies of everything required, so that the Advance, now that it has begun, may not be held up. Thousands of lives and millions of pounds sterling may be saved if we can maintain supplies so that we may continue to strike hard until the end. Yet, while the national cause demands still more labour and a sustained effort on the part of all, we are compelled to be simultaneously considering ways and means for safeguarding the interests of millions of workers when we have all won the Victory. Those who prefer to leave such things to chance, who have a dislike for any energetic movement or policy, or who would "let things slide" until it is "too late," are becoming fewer every day. We thought that the decision of the Government to appoint a number of committees to consider the after-the-war interests of various staple British industries was approved by all practical-minded students of national affairs. What are we, then, to think of the maunderings of an esteemed electrical contemporary, which, if it had a weaker faith, would deduce from the appointment of so many committees that "our country must have been in an exceedingly bad way two years ago"? It finds in the unparalleled prosperity that prevailed in our industries before the war an indication that "there is nothing fundamentally wrong with our methods." Not being willing to do "as the fool does," our contemporary, instead of "pulling down everything before we know for certain that we have something better to take their place," would endeavour "so to modify existing institutions as to bring them into line with twentieth-century requirements." What on earth *is* our contemporary driving at? Has the writer observed that there is a sort of war raging in Europe? that we and some nations whom we call our Allies are engaged in it? that the industries of the country have been turned practically upside down in order to wage that war successfully? and that, therefore, the condition of our industries and trades may need a little looking into? The seriousness and extent of the problems are so great that in one case it has been found necessary to make two committees where one was thought to be sufficient before. There may be something in the desire for co-ordination, but there is a Reconstruction Committee of the Cabinet, and as we go to press there is announced a "Commercial and Industrial Policy Committee," to which the proposals of all the other committees will find their way. The spirit that inclines a man to do nothing, and to leave alone what he calls "well," is reprehensible in these very anxious times; in the electrical world it is particularly so.

We shall, no doubt, hear many dark forebodings respecting a "sex war," but there are more immediate matters in hand, and while the future position of Labour, as a whole, is so obscure, it cannot be dealt with as a problem by itself. Indeed, at the moment, the more pressing problem regarding female labour is how to secure more of it from less essential and from leisured walks of life. For some time past the Home Office and the Board of Trade have been engaged in a vigorous campaign to that end, owing to the needs of various occupations and industries. As part of the steps taken in this campaign, an appeal, signed by the Home Secretary and the President of the Board of Trade, has been issued to employers urging them to take immediate steps to extend as far as possible the employment of women in their works. A Central Advisory Committee on Women's War Employment (Industrial) has been appointed to advise the two departments on questions arising out of the substitution of women for men and to watch the progress of this substitution in various localities and industries.

The Board have also appointed in a number of important centres local Committees under the Labour Exchanges Act, 1909, to assist the two departments in dealing with the various questions that arise locally. The work undertaken by these Committees includes the collection of information as to the labour requirements of employers in their area, the organisation of a supply of women workers, the making of arrangements for housing accommodation for women brought in from other districts, and the initiation of schemes for the welfare of the women employed in their area.

The following is a list of places where local Committees have already been or will shortly be set up:—

| | | |
|---|---|---|
| Bacup and Rawtenstall (Rossendale) | Edinburgh and Leith | Llanelly |
| Batley and Dewsbury | Glasgow | Mansfield |
| Blackburn | Gloucester | Peterborough |
| Bradford | Greenock | Nelson |
| Bristol | Grimsby | Newtown and Welshpool |
| Burnley | Halifax | Nottingham |
| Carlisle | Huddersfield | Paisley |
| Carnarvon | Hull | Preston |
| Derby | Keighley | Sheffield |
| Dundee | Kettering | Todmorden |
| Ebbw Vale | Leeds | Woolwich. |
| | Leicester | |

Further Committees will probably be appointed at a later date, as the need for their services arises.

In most of the great industries (outside munition industries) conferences with employers and operatives have been arranged by the Home Office, and the Board of Trade. In almost all cases a formal agreement has been concluded whereby the Operatives' Unions have undertaken, subject to certain conditions, to relax their trade rules in regard to the employment of women on processes hitherto regarded as men's processes. In many industries such agreements have been reached, and in others they are contemplated.

To assist in these schemes a series of pamphlets has been prepared, and others are in course of production, setting out the processes in each industry in which women have been, or can be, introduced to replace or assist male operatives; these, together with notes of any trade agreements or other relevant points of interest, are being brought to the notice of employers. An Information Bureau of the Board of Trade Employment Department has been opened at the Victoria and Albert Museum, South Kensington, and employers who are anxious to secure more information should communicate with that Bureau, where they will find on file many particulars respecting new occupations and processes for female labour.

Mr. J. H. Thomas, M.P., of the National Union of Railwaymen, in a recent speech admitted that they had no right to set up a sex war, but they had a right to say that no employer should be allowed in future to take advantage of women's labour as a means of reducing the value of man's labour. He added that there was only one way, and that was to insist that wherever women were doing the work of men they should be paid the same rates as men. Does this mean the same class of work, leaving such questions as quality and output out of account? We have had some striking cases of excellent performance on the part of women, putting male labour almost to shame, but not all the evidence, by any means, is to that effect.

We may not attach undue importance to speeches, but it is only right to keep ourselves informed of the drift of opinion among the workers and their representative spokesmen. In this connection we note that the mover of a resolution at the meeting of the Railwaymen's Union mentioned above, said that the brightest feature of the present time was the growing strength of Trade Unionism. "It was unlikely that they would have to use the power of the Alliance (railwaymen, transport workers and miners) before the international conflict was ended, but when they looked at what was likely to happen when peace was declared, the best solution they had was that which lay in their splendid organisation, for the triple Alliance could effectively look after their welfare, if they used it in the proper way."

We have already quoted in detail the proposals which this Alliance will put before Mr. Asquith when he receives the deputation.

Mr. H. Wilson Fox, of London, writing to the *Times* on the British error of the past in paying too little attention to production and too much to the interests of the consumer, expresses the conviction that the time has arrived for a change of policy. "Production must be stimulated," and "it behoves us to consider on what terms Protection (for home industries) must be given." He makes the following suggestions:—

1. Reasonable conditions of life for the workers—to be attained by means of minimum wages.

2. Participation by the State in profits exceeding a reasonable and agreed amount—to be attained by the operation of a graduated excess profits tax. The question of what should be regarded as a reasonable rate of profit for a particular industry might be determined by a Commission of experts wholly independent of the Inland Revenue authorities.

Here we may, perhaps appropriately, quote (from the *Times*) some remarks made recently by the chairman of Cammell, Laird & Co., Ltd. (Mr. W. L. Hickens), on the question of wages and profit :—

It had often been stated that Capital got too large a share of the profits of Labour, and that Labour was exploited for Capital's benefit; but if all the sums to be paid in dividends were distributed in wages by the firm, it would be well under a 10 per cent. increase. Wages could only be increased either by higher cost to the consumer or increased output, and the last-named way was the only real one in which to substantially increase wages. All this was very obvious, but, unfortunately, it was too little understood in the Labour world, where the policy of restricting output was so deeply ingrained that even at the greatest crisis in our history, when every ounce of effort was needed to win the war, it had not been, so far, overcome. However deplorable this might be, it was unreasonable to lay all the blame at Labour's door. The mistrust and suspicion which had caused restriction of output were an heritage of the past, in which employers and the Government, and, indeed, the whole community, had played their part. It was idle to recriminate and be shocked because, in the light of past experience, Labour was suspicious that speeding-up would result in a reduction in piece-work rates. The arrangements of the Ministry of Munitions to meet this problem had worked most unsatisfactorily, and led to the most absurd anomalies. The problem remained unsolved. Its solution was of more than immediate importance: it was of far greater moment to our trade after the war. It was our biggest domestic problem, and because of its difficulty was left severely alone or dismissed with the suggestion that there was bound to be trouble after the war. And there was bound to be trouble if the present policy of drift was tolerated.

*(To be continued.)*

## THE INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION, 1916.—V.

### The Application of Electricity to Agricultural Purposes.

By W. T. Kerr.

*(Abstract.)*

Up to the present time the use of electricity in farming has not attracted the attention that it undoubtedly deserves on the part of the electric supply authorities, electrical manufacturers and engineers in this country. This is the more surprising in view of the very close attention which has been given to the subject on the Continent of Europe and in America, and the important and extensive schemes for supplying agricultural areas which have been carried out in different countries.

It is noteworthy that California—a purely agricultural State—uses more power per head of population than any other American State. Canada also furnishes an interesting example of farm supply on the Ontario Hydro-Electric Commission's extensive distribution system, and practical examples of a similar kind are to be found in Australia, New Zealand and elsewhere.

There is awaiting development in this country an enormous business of a similar kind, which will also place at the disposal of the agriculturalist a labour-saving source of power and light superior to any other. The writer's conclusions are based on some years' experience in farm supply work in the neighbourhood of Hereford, where conditions are not more favourable than in many other parts of the country for this particular class of supply.* It has been rightly said that electricity can give a new stimulus to agriculture and farming, and at the same time open up a way by which the rural population can be induced to remain on the farm, instead of flocking to overcrowded cities, and taking up an entirely new form of work to earn a living.

Several of the important Continental electrical firms specialise in electrical apparatus for farms; portable motors of fairly large size are built for driving thrashing machines, &c., and some engineers in the United States have even gone so far as to incorporate the motor in the farm machine in the same manner as in modern machine-tool work.

In an article in the Electrical Review of June 4th, 1915, it is shown that very similar conditions exist in Britain, although it would seem that the average would be greater in this country, both as regards units consumed and horse-power demand, as the farm machinery in general use here is of larger and more substantial type.

*An illustrated description of the Hereford system appeared in the Electrical Review of June 11th, 1915.—Eds.

The last report of the Ontario Hydro-Electric Commission contained some particulars of farming supply in Ontario, with data as to energy used on farms; the average yearly consumption per farm for all purposes was 4,700 units, and the average revenue £27.

In the Hereford district a system of light transmission lines has been erected to reach the agricultural consumers. These are built with larch poles, 28 ft. long, with cross arms of quarter oak 2 ft. 6 in. by 3 in. by 3 in., the bottom arm 3 ft. The lines are usually now made up to 7/10 B.S.G. bare stranded aluminium, weighing about .032 lb. to the yard, and costing before the war 1s. 0½d. per lb., with two No. 12 galvanised guard wires below, which are also used as the neutral, the supply being given at 440 volts, three wire (220 volts for lighting). The total cost, including labour, works out at £110 per mile. These lines have withstood the gales of December, 1915, and March, 1916, without a breakdown.

The farthest distance a supply is given is 3,400 yd. from the generating station, 1,200 yd. of which is by overhead lines; these radiate in five districts from the station to an average distance of 3,000 yd.

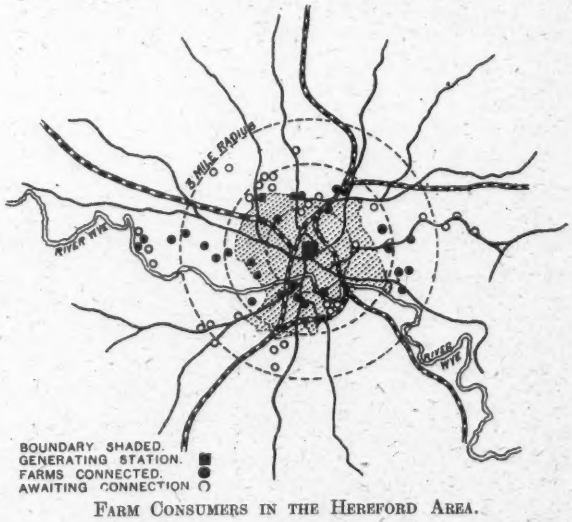
When erecting the poles, it has been found better to place them close into the hedges, otherwise the cattle use them for relieving themselves of insect life, to the detriment of the line; also farmers object to their being placed any distance out in the fields, and the hedges and ditches act as a guard. Such lines can be arranged with quite long spans, 75 yd. in places, to cut across corners, if the route is carefully considered before the erection.

Tappings to consumers are taken off by means of a twin-lead cable clipped to the pole. It is very important to seal both ends of the cable where the leads are taken off, and this is usually done at the top of the pole by securing a small sealing box to the pole and taking off leads, leaving a short bare space on the wire between the lead-covered and rubber-covered leads where the thimble is sweated, and afterwards sealing this with compound.

The connection to the aluminium wire is made by means of a "jim crow" shaped clip, which grips the wire in two positions, the lead being sweated to a screw used for tightening in the centre, and the whole joint afterwards painted over with aluminium paint; no trouble whatever has been experienced with such a joint, although one section has been in constant use for nine years, connecting up a supply to a 50-h.p. motor from an aluminium overhead line running alongside a main-line railway.

In an average case, a 10-h.p. motor will meet all the power requirements of a farm, except for thrashing and cider milling, but motors up to 20 h.p. have been hired out for these purposes, which are only seasonal jobs, and do not require a permanent fixing.

The greatest obstacle to cheap rural supply is the question of wayleaves; when it is necessary to go outside the boundary




Farm Consumers in the Hereford Area.

of a Provisional Order area to supply in a district without such an order, many unnecessary legal difficulties are encountered. A line to supply a farm building and residence was held up over twelve months, although it was only necessary to cross two small meadows, certain members of the local District Council viewing the application for permission to supply electric power as a means of negotiating for an extension of water supply to a house quite two miles away. Application was made to the Board of Trade for an over-riding order, and they suggested further negotiations before granting it. When an agreement was eventually come to, the legal costs amounted to more than twice the cost of the transmission lines.

This, obviously, is not as it should be; such obstacles prevent proper development and are a bar to progress.

A typical installation on a Hereford dairy farm consists of

an 8.5-H.P. open-type motor, running at a speed of 960 R.P.M., with the starting panel mounted alongside. A vacuum pump for the milking machinery requires 1½ H.P.; this machine is used twice daily, for about two hours in the morning and one and a quarter hours in the afternoon. The cows milked average about 70, and the machinery has a capacity of 88. The farm bailiff states that it would require at least five expert milkers to do the work in the same time, or with his present staff five or six hours a day longer.

Root-pulping and chaff-cutting machines are placed on an upper floor in order to keep out all the dust which generally arises when dry hay is being cut. The roots are thrown over into the machine hopper, and the chaff comes down a shute on the wall; the two are mixed and fed fresh to the cattle. Experience shows that owing to the easy starting of an electric motor the exact quantity of food can be cut and mixed fresh as required, a very important result being a greater yield of cream in the milk.

A machine for kibbling corn and rolling oats is installed, and a circular saw for splitting wood and fencing material. There are many other operations that could be done most efficiently by electricity. In the future an apparatus for electrically heating water will be installed. The farm buildings are lighted throughout with 25 lamps each of 25 C.P.; the bailiff's house and some cottages are supplied off the same line through "penny-in-the-slot" meters.

The units consumed on this farm for the year 1915 amounted to 2,411, at 2½d. per unit, and the revenue reached £25, or an average of 9s. 7d. weekly. The quarterly energy consumption for power was:—

| | |
|---|---|
| June ... ... ... ... ... | 369 |
| September ... ... ... ... ... | 746 |
| December ... ... ... ... ... | 665 |
| March ... ... ... ... ... | 631 |

The use of electricity means a considerable saving in labour, although the operations could be performed, as on many other farms, by oil or gas engines. Engine stopping and starting, however, require time, and it would also be necessary to send men and carts for oil or coal to the nearest town or railway station, all of which takes time, and should be added to the cost of any other type of power, but rarely is taken into account.

There are many operations requiring power always to be found in agricultural areas, which are peculiar to the particular district. An old stone cider mill in Hereford is used to crush apples, and the presses are driven by a 10-H.P. motor.

A portable motor is used for filtering and racking cider; it is also used for shearing sheep, by a flexible shaft driving the cutters, regulating being done by the controller in the motor starter.

Machines are used for the drying of spent apples after the juice has been extracted, and the apples are afterwards used for cattle food; one large machine of this description requires about 25 H.P., and runs for three months, 24 hours daily, with as few stops as possible. The same motor is used for sawing wood during other months of the year.

Similar drying machines are used for grains and spent hops, the grain being used as a cattle food and the spent hops for bedding, while the seeds from the hops are used for the preparation of a dye stuff.

In the greater part of the hop-growing district, the demand per farm would run up to 25 H.P., which would be used for spraying the hopyards, and driving fans and pocket-filling presses; it is also possible that electroculture would be of assistance in extinguishing blight, and this would open up a field of incalculable value.

The introduction of electrical ploughing, and of electrically-driven wagons for the general hauling work, is a possible development of the near future.

It requires about 1.5 acres of land to provide food for each horse kept on a farm, and the work being seasonal, at times many horses are needed for a few weeks together; again, there are many weeks when horses cannot be used owing to the land being in an unsuitable state due to weather conditions.

An electrically-driven plough or wagon would not be standing in a stable, eating its head off, and the elimination of horses would release further land for cropping. From a mechanical point of view, it would not be a difficult matter to design a machine that could be used alternately to plough, or to drive a thrasher, and which could be run into position to drive the general farm machinery. With a suitable pulley and geared counter-shafts for varying speeds, 10 to 12 H.P. would cover the power requirements for all usual operations, and the machine would be a farmer's "Mary Ann." But the vital necessity is a permanent power supply available on the farm; the rest would be simple, as no other form of power could be utilised in such a manner. The ordinary size of battery used on an electric vehicle would be sufficiently large to plough a good many acres of land, and could be charged in the usual way at night, with a boosting charge during the day if necessary.

A petrol-driven two-furrow plough weighs about 20 cwt., and develops about 11 H.P., requiring about two gallons of petrol, or benzine, per acre, with a certain amount of lubricant. The total weight of a battery on a one-ton van, for a 50-mile radius, is about 1,260 lb., giving a speed of 12 miles per hour; the total weight of the chassis is 3,400 lb., and if we substitute the plough blades for the weight of a pair of wheels and gear it to travel about 120 ft. a minute, it would be fair to assume that a battery-driven plough is not an impossible machine.

The battery charge capacity being equal to 18 KW., the cost would be very low, at usual power rates, per charge. There is little doubt that with charging facilities available, some persons would be enterprising enough to invest in such a plough and hire it out to farmers.

The ELECTRICAL REVIEW of February 11th, 1916, contained a description of an electrical ploughing gear driven from overhead lines on a Nottinghamshire farm; most farms have a certain area of arable land permanently used for cropping, round which light overhead lines could be erected to certain points, and by means of a trailing cable carried on a drum, geared with the speed of the plough to pay in and out (the cable being sheathed with tough rubber compound), the double-winding rope-hauling ploughing gear of the usual type could be dispensed with, and a plough carrying a single motor and controller used. The slow rate of speed of a plough along a furrow would not endanger the life of a trailing cable.

Electric ploughing on an extensive practical scale has been carried out in Germany, Sweden, Italy, and France, the results being usually stated to be in favour of electricity as compared with either animal, steam, or oil ploughing tackle. German investigators have declared that for really heavy ploughing, the only competitor of steam is electricity Many of the published data regarding ploughing costs are, however, not really comparable, as the local conditions, depth of ploughing, &c., greatly influence the results obtained.

In the Hereford supply area, the district is typically agricultural. The horse-power of motors in use and units consumed generally in carrying out the operations are as follows:—

| | | |
|---|---|---|
| Cider making ... ... ... | 160 H.P. | 67,404 units. |
| Milling ... ... ... ... | 142 H.P. | 347,856 ,, |
| Farmers' supply ... ... | 106 H.P. | 19,673 ,, |
| Water pumping ... ... | 157 H.P. | 331,295 ,, |
| Sawmilling ... ... ... | 130 H.P. | 22,801 ,, |

A scheme of high-tension three-phase supply has been prepared for the Hereford area, which it is proposed to carry out after the war, there being a growing demand for electricity from farmers and private residences that cannot be met by a 440-volt three-wire supply. There are as a rule five farms to the mile along an average road; there are also many ordinary country residences. We can estimate an average revenue of at least £100 per annum from the five farms, and anything from £20 to £200 from the private houses. Large country residences are only too anxious for such a permanent source of supply, and sixpence a unit could be quite easily obtained.

A few notes have been taken of the consumption and generating costs of several large mansions in the Hereford area, of which the following is typical:—

The installation consists of an oil-engine of 16 B.H.P.; a battery of 54 cells, of 400 ampere-hour capacity; and 300 25-C.P. lamps are installed.

Average cost of "Royal Daylight" oil for twelve months, 10d. per gal.; 2½ units of electricity delivered into house for every gallon used—4d. per unit for oil. There were also 25 gallons of cylinder oil used at 3s. 2d. = £3 19s. 2d. The cost of small repairs, not including repairs to wiring in the house, amounted to £4 12s. 3d. Wages of man to look after engine, &c., 28s. per week, plus house and coal, 10s. per week = £98 16s. An allowance of 15 per cent. depreciation must be made on the cost of the battery. In all such private installations the current consumption could be increased considerably. It will be found that generally those responsible for running these small lighting plants deprecate the use of anything but lighting, and put as many difficulties in the owner's way as possible, with the result that for power and other purposes numerous small oil engines are being run in out-of-the-way places, for instance, for water supply, ice making, stable work, &c.

Electric cooking and heating offer enormous possibilities, and a permanent supply would be received with open arms by the residents, who are under no misapprehension as to being able to produce electricity cheaper themselves. The average revenue in such a case should amount to between £150 and £200 per annum; the owners in most cases would be quite willing to meet the cost of the service extensions, running over their own estates, from the main supply, or agree to a minimum charge of 10 per cent. on capital cost of extension, with a kilowatt demand and small charge per unit.

In recent years a good deal of attention has been given to the future development of electric supply in this country on a wholesale scale, and some engineers have pictured a future in which the country will be served by a network of transmission lines. Such lines will in most cases have to pass through agricultural districts, which, if properly exploited by the existing supply authorities, would be in such a state of development that a paying load could be obtained along the route to commence with. In such a case it may be assumed that it would cost something like £2,000 to cut into the E.H.T. lines for a supply of low-tension energy.

Existing data show that the average consumption of current in an agricultural district with a population of 22,500 is 58 units per head, so that taking the county of Hereford as a whole, with a population of 114,296, the possible sale of energy on the same basis would amount to, say, 6,637,000 units.

This supply would be given in an area 40 miles long by 35 miles wide, from a central distributing point. Throughout England, towns of any size of over 20,000 population are 25 to 30 miles apart, with smaller towns of up to 10,000 people between; this is the case in all the agricultural areas, and the distribution lines from most E.H.T. transformer stations would thus extend to about 15 miles radius.

It will be seen that the estimated output of 6,637,000 units, at an average price of 3d. per unit, would represent a revenue of £82,962, or taking as a basis the number of farms in the county—3,573 of an average of 150 acres—and allowing the same yearly revenue as already obtained from farms connected to the Hereford city supply, viz., £25, we obtain a revenue of £89,325 from farms alone. If the farms did not all elect to use electricity, there would still remain numerous country houses and rural industries as available consumers, as well as village water supply and electric lighting installations. It is probable that the estimated consumption given would be exceeded.

As a matter of comparison, it may be pointed out that the South Metropolitan Electric Supply Co., during the year, had an output of 6,695,481 units sold, at an average price of 2.22d. per unit, resulting in a total revenue of £62,068.

In this case, mains and distributing system would be a great deal more expensive in capital cost than a system composed of E.H.T. overhead trunk lines, radiating from a transformer station in four directions and interconnected by H.T. transmission lines, off which small transformers would supply individual farms and rural consumers; it would be much easier to sell the current in these districts than in large towns where there is competition in the form of gas supply and better railway facilities for coal and oil for generating power. Electricity would have a field to exploit alone.

There are many other directions in which electricity is making headway in connection with agriculture which should not be overlooked, and the foremost of these is "Electro-Culture." Experiments that have already been carried out have given most favourable results, notably those of Mr. J. S. Newman, of Bristol, and Miss Dudgeon, of Lincluden, Dumfries.

Miss Dudgeon is still carrying on her experiments, the current supply being obtained from a 30-volt storage battery used with a spark coil and rectifying vacuum valves; these are, however, expensive instruments and quite out of the question for an ordinary farmer, besides requiring a certain amount of expert knowledge to get the best results. If a high-tension alternating supply were available, a small transformer with valves for rectifying and an automatic time-switch for controlling would be less costly, and could be built up in such a manner that it would be quite safe to place it on any farm. The current consumption alone would not be great, but the increased yield per acre of foodstuff would be of the utmost value to the country.

For the first three years, 1912, 1913 and 1914, the crop experimented on was potatoes, with the result that each season there was a considerable difference between the weight of the crop lifted off the electrified and unelectrified areas. The increase in yield of tubers lifted under the discharge wires over those from the control was in 1912 1,209 lb., in 1913 1,561 lb., and in 1914 2,633 lb.

The total acreage under potatoes in the United Kingdom was for years 1911 to 1913, 1,200,000 acres, and the average yield per acre 5 tons 7 cwt.

Last year, 1915, the crop chosen for experiment was oats, which was grown on the same field as used in previous trials for potatoes. The season was an exceptionally dry one, there was a scorching sun, and the field being of a gravelly nature, devoid of all shade, these combined conditions were not conducive to the harvesting of a heavy crop.

From the very commencement of the growth, the oats under the electrified network showed a conspicuous difference in comparison with the unelectrified, and did not suffer from the prevailing drought to the same extent; which fact seems to confirm the theory suggested by Prof. Lemstrom, that the electrified current causes an ascent of liquid in the capillary tubes of the plant, and by means of this attraction it is quite possible that these tubes obtained moisture from a lower stratum, which the plants not under the discharge were unable to do.

When the crop was ripe for harvesting the two plots were cut, thrashed, and weighed separately, showing the remarkable difference of 31 per cent. in grain, and 63 per cent. in straw, in favour of the electrified oats.

The subject of electroculture is still in the experimental stage, but it may be remarked that the majority of the numerous investigators in this field are optimistic as to the future, and more than one foreign Government is officially investigating the matter. From the farmer's point of view the first cost of the installation appears to be the dominating factor; the power requisite would be comparatively small—Mr. J. E. Newman estimated that 1 H.P. would be sufficient for 50 acres. The fact of electricity being required for such a purpose would, however, inevitably lead to its adoption for lighting and power purposes.

Some of the other uses of electricity in agriculture are the incubation of chickens, and chicken culture, an industry rapidly gaining in importance in England. Eggs hatched in incubators sometimes yield a percentage of weakly chickens, so that many young chicks die during the first few days.

The application of suitable high-frequency current for the chicks almost entirely prevents this death, owing to its stimulating effect, while they gain weight on their normal amount of food at an increased rate, becoming in two months as heavy as chickens grown for three in the ordinary way.

According to the *Electrical World*, the great sheep ranches in the stock-raising regions of Oregon are large consumers of electricity for light and power. Central-station energy is used for pumping in the irrigation districts and for chopping grain for stock feed in the winter. In one of the stock-raising farms, electricity has been put to a novel use for the winter fattening of sheep.

The sheep pens are wired, and the electric light is turned on during the winter months from 4 p.m. to 9 p.m. Under this artificial illumination the sheep continue to feed until the lights are extinguished; at 4 a.m. the lamps are again turned on and then burned until daylight, and again the sheep feed. In this way the sheep are made to feed during the equivalent of a long summer day, and thus, despite the winter season, are brought quickly to the condition for marketing.

The foregoing notes represent only a brief outline of the possible directions for electrical development in connection with agriculture. No reference has been made to the domestic uses of electricity on the farm, which will almost certainly exceed those of the town consumer; nor has any mention been made of future developments in connection with the production of artificial fertilisers by electrical means. For the moment it is sufficient to point out that electric power and light appeals so strongly to the agriculturist that but little exertion would be required on the part of the central-station authorities to secure a really profitable business.

Successful as individual efforts might be, the results obtained would be insignificant compared with those which might be secured were an organised campaign in favour of agricultural electrical supply to be instituted, and efforts made to equip demonstration farms in suitable districts near existing towns.

Concerted action is strongly called for, both for private reasons, to frustrate the efforts of the oil-engine makers to monopolise the farmer's power business, and on national grounds, because it is imperative that no effort be spared in obtaining the mutual support of our industries with a view to securing the maximum of industrial efficiency after the war.

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## Discussion.

The discussion was opened by Coun. Langford (Hereford), who, speaking as a practical farmer, gave a short account of the use he was making of electricity supply. He employed electricity for driving a milking machine for 80 cows, for chaff cutting, root pulping, water pumping, and sheep shearing; he lighted all the farm buildings and the yard, and, in addition, operated a cider making plant electrically. He was satisfied that agriculture offered great scope for the electrical engineer in regard to power, light, &c. However, there were certain other things which he wanted to do electrically, such as to plough the land, till it, mow grass, reap it, and haul it home, all matters which the present skilled labour shortage had brought to the front. Moreover, in a dry season he wanted to be able to pump river water on to the land and irrigate it. As a market gardener with 12,000 apple and plum trees, and 4,000 current bushes, he appreciated how much easier it would be to wash the trees and keep down blight if electricity were available there. He had arranged to give electroculture a trial, but this was now deferred till after the war. He had been connected with farming for 24 years, and had scrapped steam power for oil power, and later turned from oil to electricity; to-day many farmers had said good-bye to steam, but others were waiting for electricity to come along. The steam engine was dirty, noisy, and thirsty, and the oil engine was apt to jib at times, and the smoke affected the milk, unless great care was taken. It was possible to procure an electric motor for about half the cost of the steam or oil engine, which was a great consideration to the farmer; then, no engine-driver was required if electricity were used, and that represented a saving of £70 or £80 a year. From experience, he found electrical equipment extremely reliable, the only trouble having been the blowing of fuses, and there was no possible contamination of the milk. The motor took practically no room, and it required no space for fuel storage. He thought the advantages of electric light were even greater than those of electric power, as it enabled working hours to be extended by as much as three hours in winter, and was a great improvement over hand oil lamps. As an instance of the results, he mentioned the case of a farm hand who gave notice for the sole reason that he had never worked so many hours a day before. Electric supply to farms would confer a great boon on agriculture and on the nation; he was quite certain that if the problem was generally attacked a successful result would be attained.

Mr. Frank Ayton (Ipswich) said those engineers who were intent on getting the agricultural load would find much useful matter in the paper. A battery-driven plough on the lines suggested by the author would require a very large battery to provide for emergencies. The paper raised the question of wayleaves; they must get more reasonable legislation on that matter, and he suggested that the Association had stronger grounds now for making representations to the Government on the subject. It would probably be necessary to adopt the three-phase H.T. system of supply, and suitable

plant could easily be added to existing direct-current stations. Engineers must educate the agriculturists in their vicinity on the subject through the local papers.

Coun. DYMOND (Hereford) pointed out that their local farmers did not need educating, they were "howling" for the supply, and just now could not get it. Leaving out four large consumers, the remaining 983 ordinary consumers gave them an average income of £5 12s. each, while the 19 agricultural consumers paid them an average of £25 apiece, showing the value of this type of consumer, which, so far as he could see, should be the case in other districts. The bar to connecting all the farmers in the district was the wayleave difficulty; the process of obtaining leave for one connection had to be all repeated for another. The present was an appropriate time to get the agricultural load, as the questions of labour saving and increasing agricultural production were very much to the front. If the local authorities could get resolutions passed by local agricultural councils and forward them to the Board of Agriculture, which in turn would deal with the Board of Trade, they might get some amelioration of the conditions hampering supply in rural areas. Electroculture was in an experimental stage, because electricity supply was so rarely available on the farm, but in the future great developments would take place, and he thought that the increased value of the crops which would be obtained would be out of all proportion to the cost of electricity used in obtaining it, and that they should be allowed to charge a special rate for such a purpose. For many years much technical supervision would be required, and the supply would be worth a good deal more than the statutory maximum of 8d. per unit.

Mr. W. B. WOODHOUSE (Yorkshire Power Co.) said attention should be drawn to the lessened fire risk when using electricity on the farm. Many small farmers were using energy from the Yorkshire Power Co.'s mains, being supplied through pole-type transformers. If the farmer wanted a supply, the wayleave was easily obtained. The Yorkshire Agricultural Council had carried out an interesting investigation to find out the influence of smoke on vegetation in the town and at various distances outside. In the case of a lettuce, grown under comparable conditions and watered with rain-water obtained in the centre of Leeds, it was found to weigh 44 grm. as against 56 grm. one mile out, 120 grm. 3½ miles out, and 175 grm. 6½ miles out, showing the effect of the acid in the smoke, which would be practically done away with by the adoption of electrical methods in the town.

Mr. S. E. BRITTON (Chester) mentioned that he had been supplying a 500-acre farm during the last twelve months; previously the farmer used coal, costing £33, and this had been replaced by electricity, costing £23 (at 1d. per unit), and the farmer was delighted with the result.

Mr. BEXON (Kilmarnock) said they had five farms connected to their H.T. transmission system*, and the annual revenue varied from £15 to £19; all the farmers were quite satisfied that electricity was much cheaper than steam, and he was now connecting another five farms. The supply was given through pole transformers, and it had facilitated obtaining wayleaves across agricultural land.

Coun. LANGFORD, replying to Mr. Fedden, assured him that the modern milking machine was quite satisfactory in use, and the suction was adjusted to allow for the gradually diminishing pressure of milk.

Mr. WILLIAM LOW (Marykirk), in a communication, said he had been using electricity for farm purposes for a number of years, having developed a small water power and taken the supply a distance of 2,000 yds. A dry summer stopped the plant, and he regarded it as essential for the supply to be available always, which could only be guaranteed by a public supply undertaking. The overhead line consisted of six strands of No. 4 hard-drawn copper, 16 ft. above ground, with poles 65 yds. apart. Electricity was used for lighting buildings and cottages, and for threshing—a 15-H.P. motor, 660 R.P.M., being employed to drive the mill and straw carrier; for driving a cream separator, an operation taking 20 to 30 minutes, and releasing a dairymaid for other work; he considered that the electric motor had great advantages over steam or oil power. He had some doubt as to the feasibility of electric ploughing, and would not recommend a battery-driven wagon to pull the plough, while the cost of conductors at every fence on a farm would be great for seasonal use and ugly. He used a 15-H.P. motor to drive a band saw for timber cutting, and found it more satisfactory than the circular saw; the same motor was used to drive a stone breaker for road repairs. Water pumping was also done at two points, using a 1-H.P. motor. A 1-H.P. motor driving a mangle was considered to save quite a day's work a week. Electricity was used for heating by means of radiators, and a ventilating fan was a convenience. A cold storage plant driven by a 2½-H.P. motor was also in use, and no doubt there was a future before electric cooking, given a reliable supply. He had experimented in electroculture for six years, and while he was satisfied that he obtained increased crops under certain conditions, he was not able to ascertain the cost. Such experiments were necessarily uncertain owing, amongst other things, to the wind carrying the discharge away from the plot, often on to the control plot if situated to leeward. He had tried to intercept part of the drifting discharge by means of small-mesh wire netting, but did not prevent it getting to the control with a wind in that direction. A difference of 20 per cent. was observed on two different hay plots in 1914, but the year was exceptional, as the wind blew continuously from the control plot. In conclusion, he suggested that the supply authorities, in view of the results being obtained by the author and others, should endeavour to interest the agricultural and rural community in the subject.

The author decided to contribute his reply to the *Proceedings*.

[Mr. BEXON, in a letter received by us before the Convention, stated that electricity was used by local farmers for lighting, ironing, heating, motors for crushing and chopping, and for driving milking machines. He added that when the question of farm supply first arose, he was personally of opinion that it would yield a very poor revenue, but *from experience he found that the revenue obtained was very good.*]

*See ELECTRICAL REVIEW, June 16th and 23rd, 1916.

## THE NATIONAL PHYSICAL LABORATORY.

THE report of the Executive Committee for the year ended March 31st, 1916, was submitted to the General Board at a meeting on June 20th, 1916. It states that the work of the Laboratory has been greatly affected by the war, ordinary research work having to give way to special investigation undertaken for Government departments. Sir Wm. Crookes's term of office as President of the Royal Society having expired in November last, his successor, Sir J. J. Thomson, is now chairman of the General Board. Two members of the staff, Mr. Donald Ewen and Mr. H. E. Barwood, have given their lives for their country, while, on the other hand, Mr. G. H. Millar, taken prisoner at Antwerp, escaped from Döberitz, and has been given a commission. Over 40 members of the staff are serving with the Forces; the remainder have not been permitted to enlist, owing to the demands of the Government on the services of the Laboratory, and owing to the great increase in the work, many temporary additions have been made to the staff. By desire of the Committee of the Privy Council for Scientific and Industrial Research, particulars have been laid before it as to various researches in which the Laboratory can be of assistance to British industries, and during the year help has been given to a number of firms which have undertaken the manufacture of goods formerly obtainable only from German sources. Additional buildings have been erected for aeronautical research.

In the Physics Department (Mr. F. E. Smith), the Electrical Standards Division has been occupied with the investigation of problems in connection with wireless telegraphy. The Division for General Electrical Measurements has continued the research on magnet steels for the I.E.E., and in the Electrotechnics Division Mr. C. C. Paterson has made arrangements for a new branch of test work. Other departments, whilst largely engaged on Government work, have been able to make some progress with their normal duties.

In the Physics Department, in addition to special tests for the Ministry of Munitions, 140 electrical measurements were made, compared with 191 last year and 259 in 1914; under the head of Electrotechnics, 10,444 tests were made, including 3,171 ammeters and 3,136 voltmeters, 1,954 shunts, and 1,224 supply meters, compared with totals of 5,080 last year and 3,828 in 1914; photometric tests numbered 3,053, including 2,324 luminous dials (a new item), compared with 410 and 1,142 in 1915 and 1914.

The accounts show a credit balance of £1,568. The income rose from £39,653 to £51,372, and the expenditure from £39,573 to £49,804. The staff increased from 217 to 337.

*Physics Department.*—Much of the time of the "Fundamental Units" Section (Mr. F. E. Smith) has been occupied with confidential work; in addition, the improvement of compasses for use in the lifeboats of merchant ships, and the testing of prismatic compasses for Service use, were amongst the matters dealt with. In the section for General Electrical Measurements (Mr. Campbell and Mr. Dye) an inductometer suitable for high frequencies, and having a wide range of self-inductance, has been constructed, and three new sensitive vibration galvanometers have been built. The improvement of methods of testing the magnetic properties of bars has received attention, and a paper communicated to the Institution of Electrical Engineers (ELEC. REV., December 31st, 1915, p. 859) gave a full account of the new methods.

*Electrotechnics* (Mr. Paterson).—The test work has been mainly of a confidential character, and practically all ordinary research work has been suspended. The setting-up of standards for, and the testing of, self-luminous dials for aeroplane and other instruments for use at night has necessitated the collection of much valuable and interesting information on the behaviour of the luminous compounds and of the completed dials. In the D.C. and resistance measurement section, the amount of work has been more than three times that of the heaviest pre-war year, though the staff is numerically the same as before the war. In the case of large current shunts, the design of the main current terminals has been found to be most important; in one instance, owing to the design of the end connections, a difference of 8 per cent. could be obtained, depending on the method of leading in the current.

In testing the large shunts which are now being dealt with, it is necessary to maintain the full current until the shunt has attained its maximum temperature, in order to obtain the correct values for running conditions, to detect weakness of the soldered joints—the most prolific source of trouble in this type of apparatus; the present battery arrangements do not allow of a discharge sufficiently great or prolonged for this purpose, and it is hoped to obtain a machine suitable for coupling in parallel with the battery.

*Heat* (Dr. Harker).—Resistance thermometry has been further investigated, and a special apparatus which has been constructed for the purpose of testing the heat insulating properties of refractory materials has proved exceedingly satisfactory; thermocouples are employed for the temperature measurements, and to maintain good thermal contact over the surface of the bricks, a bath of molten tin electrically heated to a uniform temperature is employed. Electric heating is also used in testing the thermal conductivity of slag wool, cork, &c., and the thermal properties of new roofing materials. In the latter case, although the conductivity of the materials was of the order of 1/70th that of iron, the unexpected result was that the loss of heat per sq. ft. was 20 per cent. greater than that through galvanised iron. This apparent anomaly is explained by the greater surface emissivity of the new materials. The Melloni form of thermopile was found to be most useful in investigating the loss of heat from surfaces at a temperature only slightly exceeding that of the surroundings. For testing optical pyrometers, a new pattern of carbon tube furnace was designed by Mr. C. G. Eden, and has been in constant use for about five months at temperatures ranging up to more than 2,000 deg. C. without necessitating the replacement of the original tube; the furnace takes 1½ KW. at the highest temperatures. The abnormally large demand for porcelain tubes for pyrometer sheaths, which before the war were largely obtained from abroad, necessitated the production of suitable ware in this country, and investigations have been carried out on samples of British-made porcelain tubes. An enlarged form of the tungsten arc lamp of Messrs. Gimingham & Mullard, made by the Edison-Swan Co., with a hot electrode 8 mm. in diameter, has been found to be an extremely useful source of radiation for optical pyrometer work.

*Radium and X-ray Work* (Dr. Kaye).—Tests on radium salts and radium luminous compounds (zinc sulphide + 0.04 per cent. by weight of radium bromide) have been carried out, and apparatus has been installed to investigate the absorption-coefficients of materials used for the protection of X-ray operators.

The Engineering, Metallurgical, and Tank Departments have all been very busy. An appendix to the Report gives particulars and drawings of the new aeronautical buildings. For these a separate motor-generator working at 400 volts has been installed, with a Tirrill regulator, which maintains the voltage at a constant value independent of the load on the generator, and thus enables the two new wind-channels to be used without affecting each other's working.

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**Electrical Trade in 1915: New Classification.**—We are asked to state that certain alterations in classification, recommended by the B.E.A.M.A. to the Board of Trade in 1914, will appear in the Annual Statement of Trade of the United Kingdom covering 1915, which, it is anticipated, will be issued shortly.

The new classification will be as follows :—

IMPORT LIST.

Electrical goods and apparatus, &c. :—
- Meters and measuring instruments.
- Switchboards.
- Unenumerated.

Machinery and parts thereof :—
- Electrical :
  - Generators and motors (except for aeroplanes, motor-cars and motor-cycles).
  - Unenumerated.

EXPORT LIST.

Electrical goods and apparatus, &c. :—
- Meters and measuring instruments.
- Transformers.
- Switchboards.
- Unenumerated.

Machinery and parts thereof :—
- Prime movers (except electrical).

Other kinds :—
- Steam reciprocating engines.
- Steam-turbine engines.
- Internal-combustion engines (except for aeroplanes, motor-cars and motor-cycles).
- Unenumerated.

Electrical :—
- Railway and tramway motors.
- Other generators and motors (except for aeroplanes, motor-cars and motor-cycles.
- Unenumerated.

## NEW PATENTS APPLIED FOR, 1916.

**(NOT YET PUBLISHED).**

Published expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

9,277. "Driving and controlling dynamo-electric generators." J. FIRTH and W. F. W. RHODES. July 3rd.

9,279. "Field regulating rheostats, motor starters, &c." ELECTROMOTORS, LTD., P. O. L. PELLOWE & D. A. TRICKETT. July 3rd.

9,310. "Combined pocket and suspension electric lamp." C. R. HALL. July 3rd.

9,335. "Continuous-current dynamo-electric machines." F. MURGATROYD. July 3rd.

9,336. "Electrical replacement indicators." H. J. DALE. July 3rd.

9,349. "Automatic switching devices for telephone systems." L. DE FOREST. July 3rd. (U.S.A., July 7th, 1915.)

9,370. "Electric lamp, &c., guards." ST. HELENS CABLE & RUBBER CO. AND J. C. WHITE. July 4th.

9,371. "Devices for gripping or securing electric cables, &c." ST. HELENS CABLE & RUBBER CO. & J. C. WHITE. July 4th.

9,408. "Electric hand lamps." J. W. MANLEY. July 4th.

9,447. "Ships' telegraphic apparatus." W. CHADBURN & W. R. CHADBURN. July 5th.

9,539. "Measurement of frequency of electrical currents." MARCONI'S WIRELESS TELEGRAPH CO. & I. SCHOENBERG. July 6th.

9,541. "Electric rotary converters." BRITISH WESTINGHOUSE ELECTRIC AND MANUFACTURING CO. July 6th. (U.S.A., July 6th, 1915.)

9,589. "Firing ordnance by electricity." P. DE BEER & G. INRIG. July 7th.

9,598. "Electrodes." J. C. ROUND. July 7th.

9,607. "Code telegraphy." F. B. DEHN (R. C. H. Martens). July 7th.

9,608. "Evacuating bulbs of electric incandescent lamps, &c." DEUTSCHE GASGLUHLICHT AKT. GES. (Auerges). July 7th. (Germany, September 27th, 1915.)

9,609. "Electric incandescent lamps and production of same." DEUTSCHE GASGLUHLICHT AKT. GES. (Auerges). July 7th. (Germany, September 27th, 1915.)

9,635. "Producing electricity." A. MACCALLUM. July 8th.

9,646. "Electric switches." J. ANDERSON & G. ELLISON. July 8th.

9,647. "Electric contacts." J. ANDERSON & G. ELLISON. July 8th.

9,655. "Electric signalling systems." F. G. BELL, W. C. DAVEY AND STERLING TELEPHONE & ELECTRIC CO., LTD. July 8th.

9,667. "Motor ploughs, cultivating implements, cable-laying machines, &c." W. E. MARTIN. July 8th.

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## PUBLISHED SPECIFICATIONS.

### 1914.

7,591. ELECTRIC INCANDESCENT LAMPS. A.B.C. Schriftlampen Ges. March 25th. (November 20th, 1913.)

7,890. USE OF INTERRUPTED CURRENT AS METHOD OF EFFECTING AN INITIAL QUIVERING IN THE VIBRATION OF BODIES BY ELECTRICITY, MORE ESPECIALLY THE STRINGS OF MUSICAL INSTRUMENTS, SUCH AS THE PIANO. A. H. Maitre and V. H. G. Martin. March 28th.

### 1915.

1,950. SWITCHES FOR USE IN IGNITION SYSTEMS FOR INTERNAL-COMBUSTION ENGINES. B. P. Swyers. February 6th.

4,222. MEANS FOR CONTROLLING ELECTRIC AND OTHER MOTORS. Akt. Ges. Brown, Boveri et Cie. March 17th. (March 19th, 1914.)

7,341. APPARATUS FOR MEASURING ELECTRIC CURRENT. Landis & Gyr. Akt. Ges. May 15th. (May 18th, 1914. Addition to 3,856/15.)

7,457. ELECTRICAL DISTRIBUTING SYSTEM. W. H. Cole. May 18th.

8,826. TELEPHONE SYSTEMS. C. Bardeloni. June 15th.

8,926. WIRELESS TELEGRAPH RECEIVERS. Marconi's Wireless Telegraph Co. and G. M. Wright. June 17th.

9,054. MAGNETOS. M. Pedersen. June 21st.

9,097. ELECTRIC HOT-WATER STORAGE INSTALLATIONS. E. C. R. Marks (Walker). June 21st.

9,111. SYSTEMS FOR PRODUCING ELECTRICAL DISCHARGES FROM A SOURCE OF ENERGY. Varley Duplex Magnet Co. & R. Varley. June 21st. (Addition to 17,607/13. Convention date not granted.)

9,112. SYSTEMS FOR PRODUCING ELECTRICAL DISCHARGES FROM A SOURCE OF ENERGY. Varley Duplex Magnet Co. & R. Varley. June 21st. (Addition to 17,607/13. Convention date not granted.)

9,283. AUTOMATIC OR SEMI-AUTOMATIC TELEPHONE SYSTEMS. Relay Automatic Telephone Co. (G. A. Betulander). June 24th.

9,396. TELEPHONE SYSTEMS. Automatic Telephone Manufacturing Co. June 26th. (June 27th, 1914.)

10,137. PRIMARY CELLS. F. A. Wilkinson. July 12th.

10,147. STAND FOR COILED MATERIAL. S. C. Cary. July 12th.

10,605. ELECTROLYSIS. H. R. Nelson. July 21st. (August 17th, 1914.)

11,768. SYSTEMS OF CONTROL FOR ELECTRIC MOTORS. British Thomson-Houston Co. (General Electric Co., U.S.A.). August 14th.

13,286. METHOD OF MANUFACTURING GEAR WHEELS. British Thomson-Houston Co. (General Electric Co., U.S.A.). September 17th.

14,895. MAGNETS FOR/OF MAGNETOS. M. Pedersen. October 21st. (Divided application on 9,054/15. June 21st.)

14,896. MAKE-AND-BREAK MECHANISM FOR/OF MAGNETOS. M. Pedersen. October 21st. (Divided application on 9,054/15. June 21st.)

14,898. ARMATURES OF MAGNETOS. M. Pedersen. October 21st. (Divided application on 9,054/15. June 21st.)

16,933. ELECTRIC ROTARY CONVERTERS. O. H. Pieper & A. F. Pieper. December 1st.

17,022. CURRENT REGULATORS FOR ELECTRIC FURNACES. Aktiebolaget Elektriska Ungar. December 3rd. (December 16th, 1914.)

17,580. ELECTRON EMITTING CATHODES AND PROCESS OF MANUFACTURING THE SAME. A. M. Nicolson & E. C. Hull. December 16th. (December 26th, 1914.)